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**AN EVALUATION OF THE
TOTAL PACKAGE PROCUREMENT CONCEPT
AS EXEMPLIFIED BY THREE AIR FORCE
WEAPON SYSTEM CONTRACTS**

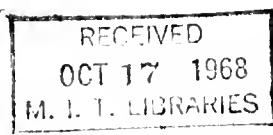
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AN EVALUATION OF THE
TOTAL PACKAGE PROCUREMENT CONCEPT
AS EXEMPLIFIED BY THREE AIR FORCE
WEAPON SYSTEM CONTRACTS

by

Albert J. Gravallese

Submitted to the Alfred P. Sloan School of Management on May 17, 1968 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

A recent trend in Air Force procurement practices has required potential contractors on major weapon systems to compete for fixed price incentive contracts covering all phases of system acquisition--research and development, production, and as much follow-on support as feasible. This total package procurement concept (TPPC) represents an attempt to circumvent the weaknesses of conventional procurement practices, which involve separate, sequential contracts for development and production.

This study evaluates the TPPC by comparing its intended objectives with the actual experiences of contractors and Air Force procurement officers. Three specific total package contracts were studied:

1. Lockheed's C-5A military cargo transport;
2. Boeing's AGM-69A short-range attack missile (SRAM); and
3. Avco's Mark 17 reentry system.

Although none of these contracts has been completed, each has progressed far enough into development to permit meaningful assessment of performance.

A review of the literature and personal communication with the "architect" of the TPPC provided a definition of the concept's intended objectives, against

which performance could be evaluated. Performance was judged by interviews with senior-level contractor and Air Force personnel who guided the programs listed above.

Results of the study show that, in general, the total package procurement concept falls short of its intended objectives. Its major advantage is the provision of firm government visibility of probable production costs. However, system requirements do not seem to be better defined; "buying-in" continues to prevail; and maintainability, reliability, and economy are not significantly improved. In addition, some benefits ascribed to the TPPC are actually common to all competitive fixed price incentive contracts (i. e., efficiency and careful selection of sources of supplies).

Based on these conclusions and other observations provided by the study, it is recommended that strict limits be placed on candidate programs for total package procurement. Only those programs which are generally independent of any major system, and whose systems effectiveness can be quantitatively defined, should be considered for the TPPC. Candidate programs should also have a very low probability of change, and should not include undefined multiple and/or concurrent interfaces. Strategic weapons are not good candidates for total package procurement, nor are systems whose qualitative performance parameters are based on assessments of enemy capabilities.

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I. INTRODUCTION

This study explores a new method of major weapon system procurement that requires potential government contractors to compete for a fixed price incentive contract for both the research and development phase and the production phase. In addition to surveying the issues leading to the development of this procurement concept, three large defensive weapon systems procured under this concept have been selected for study to determine whether the anticipated advantages of total package procurement have in fact been realized.

PROBLEM DEFINITION

Spurred by the Russian space program -- and in particular, the Sputnik launches -- the United States embarked on several major weapon systems acquisitions on the basis of a cost plus reimbursement procurement environment. To accelerate development, most defense contracts were awarded on a cost plus fixed fee or cost plus incentive fee basis with tight schedules. Government cost analyses on these accelerated cost reimbursement programs led to a revolution in the management of government contract procurement.

Initially, this revolution started with competitive procurements for research and development, although still in a cost reimbursement atmosphere. To field this system, the government found itself in a sole-source environment for the production units, since competition at this stage would be costly and time consuming, requiring that another contractor be brought up to the initial contractor's technology advantage (gained through R&D efforts). At best, contracts for

production were required to be bid on a fixed price incentive basis to place more risk on the contractor and thus define total cost to the government. Although this procedure created many efficiencies in the awarding of production contracts, awards in a sole-source environment were not particularly negotiable and were significantly higher than estimates generated in the R&D phase.

This led to another giant step--contracting, in the environment of competition, all anticipated research, development, production, and as much support as possible as one "total procurement". Such a contract would contain a fixed price and performance commitment at the outset.

METHOD OF ANALYSIS

This study investigates the evolution of this new weapon systems procurement technique by:

1. reviewing the documentation leading to its definition, and
2. examining the three major Air Force weapon system programs that have been awarded on the basis of this procurement concept.

This study is restricted to three Air Force contracts because: 1) the other service agencies have not let enough contracts under the auspices of the total package concept to provide an adequate data base for case analysis; 2) the three contracts selected are the only ones awarded following a contract definition phase (an essential element of the total package procurement); 3) the Air Force conceived the concept; and 4) insufficient time has elapsed on other quasi-total package contracts to permit meaningful performance analysis. The three contracts are:

1. Lockheed's military aircraft cargo transport, the C-5A Galaxy;
2. Boeing's short-range attack missile (SRAM) AGM-69A, for use with the FB-111 and B-52 bombers; and
3. Avco's Mark 17 Reentry System, for use on the Minuteman ICBM.

The first of these contracts, the C-5A, was awarded in October, 1965.

Although other "partial" total package contracts have been awarded, only these three have been programmed for a contract definition phase, which is the first step in assessing the merits of a total package procurement. In the words of Assistant Secretary of the Air Force (Installations and Logistics) Robert H. Charles, the father of the concept, "Any program that has been approved for a contract definition phase is a candidate for a total package."¹ None of the contracts selected have been completed, but they have progressed sufficiently to permit a preliminary assessment of the advantages of the procurement concept which have been achieved to date.

The study attempts to concentrate on defining the technological and management information required by government and industry prior to the consummation of a fixed-price total package government procurement. In addition to documenting the available references on the total package concept, investigation of the three selected contracts included in-depth field interviewing of both the contractors and government agencies responsible for implementing the programs. The interview guide in Appendix A was used for this phase of the research. A matrix

¹Personal communication, February 28, 1968.

of the types of personnel interviewed is presented in Table I.² The procurement elements relative to the three programs studies are presented in Appendixes B through D. The information for these appendixes was derived from the respective Requests for Proposals, the model contracts, and from contractor-supplied data identified in the Background Data Questionnaire (Appendix E).

RELATED STUDIES

An earlier study of the total package concept³ was undertaken by the Logistics Management Institute (LMI) at the request of the Department of Defense (DoD). This is perhaps the most comprehensive study to date of the procurement methods employed, and it presents an initial evaluation of the success of the concept. At the time of publication, however, the programs were in their infancy; it is not clear therefore whether or not the conclusions reached will stand the test of time.

This report attempts to expand knowledge of the concept by adding an extra 1-1/2 years of experience to the published literature. Throughout the present study, total package procurement is compared with previous cost reimbursement sequential development and production procurements on programs of like magnitude. It is not apparent that this can be done with any quantitative definitive analysis, since all of the total package procurements have very long term program commitments, extending well beyond three years and for as much as ten years. Therefore, an ultimate comparative evaluation of contract performance under the total package will be very difficult if not impossible.

²These interviews were supplemented by discussions with senior-level procurement personnel in the Department of Defense, i.e., Asst. Air Force Secretary, Air Staff, Director of Defense, Research and Engineering, and Air Force Systems Command.

³Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June 1967.

TABLE I
INTERVIEWEE MATRIX

	C -5A	SRAM	MARK 17
Contractor	Lockheed (Marietta, Ga.)	Boeing (Seattle, Wash.)	Avco (Wilmington, Mass.)
Prog. Mgr. /Director	X	X	X
Contract Administrator	X	X	X
Program Control Mgr.	X	X	X
Chief Engineer	X		X
Local AF Plant Rep.	Lockheed (Marietta, Ga.)	Boeing (Seattle, Wash.)	Avco (Wilmington, Mass.)
Chief	X		X
Assistant Chief	X		X
Air Force Program Office	Aeronautical Systems Div. (Wright-Patterson AFB, Dayton, Ohio)	Aeronautical Systems Div. (Wright-Patterson AFB, Dayton, Ohio)	Space & Missile Systems Organization (NAFB, San Bernardino, Calif.)
Director	X	X	X
Deputy	X	X	X
Contract Officer	X	X	X
Chief Engineer	X	X	X

STUDY APPROACH

The total package concept is an all-inclusive procurement procedure combining standard practices with many new innovations in management, program definition, incentives, life cycle costing, fixed prices, competition, and above all, a commitment to production at the outset of development. Many of the interviewees--both contractor and Air Force personnel--stated their reactions to the total package concept, but in fact were reacting to specific elements of the total procurement which could be part of any standard sequential procurement. As with any novel idea, people credited or blamed the overall (new) concept when their comments actually applied to an existing procedural element that was only part of a total concept.

Nevertheless, it was necessary to examine each of these procedural elements and phases of procurement to judge their effect on the overall objective (i.e., to encourage a government contractor to assume greater risk in return for wider profit margins by committing him, under competition, to sign a binding contract for development, production, and as much of an operational system as could be defined prior to the start of development).

To better evaluate the results of the contracts chosen to illustrate the concept, it is necessary to explore the antecedents of the new procurement method, the evolution of the concept, and the definition of what the concept meant to its inventors. In addition, it is necessary to examine the proposed advantages and to determine the initial expectations regarding program efficiency and overall government savings.

The next step in the study required an understanding of the basic phases of total package procurement, such as pre-contract activity, formulation of Request for Proposals (RFPs) for the contract definition phase, development of a model contract, source selection procedures, and administration of development and production. It was also necessary to examine the intent and results of the contract definition, from both the government and contractor viewpoints.

Several interviews were conducted with both prime contractor and Air Force personnel involved in implementing the total package contracts. These were senior-level management personnel, responsible to their companies and the government for the implementation, progress, and results of the contracts. Many of the interviews required as much as three hours to explore the questions posed in Appendix A. The interview guide resulted from a search of the literature to determine the issues raised by the proponents and critics of the total package procurement concept.

The conclusions reached reflect an analysis of the responses from interviewees and a digest of the reports, not only on the total package concept but also on related procurement elements, with primary emphasis on the actual conduct of the contracts as seen by those responsible for the results.

II. CONCEPT DEVELOPMENT

EARLY HISTORY

Soon after the Second World War, the Air Force was faced with large-scale programs to develop major weapon systems. These systems were oriented toward missile programs which required a substantial amount of research, development, and technical innovation. Research and development budgets for guided missile programs were increasing very rapidly. More significantly, however, the costs of these programs during the 1950's were rising even more rapidly than the budgets. Inadequate definition of total program requirements was generally the cause for escalation of costs. Program development concentrated on the technological improvements and was not well integrated into a total system capability.

As a system capability developed, it appeared that operational deployment of the system occurred much later than initial expectations, that the mission evaporated, that the quality of the program was generally less than anticipated, and that costs were far beyond budgets. While the program quality and the mission and schedule completion dates could be considered qualitatively, it was difficult to apply management controls to the evaluation of these factors since many changes during the program led to the problems cited above. Those who tried to analyze the cost escalation (which was, on the average, three times the original cost estimates) concluded that its cause was poor definition of the project.¹ Most of the development during this period was accomplished under cost reimbursement contracts. These contracts not only provided contractors with

¹Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process: An Economic Analysis, p. 24.

a fixed fee against any costs accumulated on the program, but also provided relatively lax methods of adding on additional effort bearing fee dollars. The trend for reducing cost was not to define the system requirements better, but to provide contractors with an incentive for reducing costs.

TOWARD INCENTIVE CONTRACTS .

In 1961, the new administration attempted to meet this problem with a greater use of incentive contracts. The Defense Department intended to increase rewards for good performance and institute penalties for poor performance through the use of incentive-type contracts. Cost plus fixed fee (CPFF) awards dropped from 38 per cent of the total dollar volume of Defense Department awards during the first nine months of fiscal 1961 to 22.7 per cent during the same period of fiscal 1963.² The sharpest drop was in CPFF Air Force procurements, which decreased from 50.6 per cent of the total nine-month dollar volume in fiscal 1961 to 31.2 per cent for the same period in fiscal 1963. Percentage changes in other types of Air Force contracting during this same period were as follows:

1. Firm fixed price (FFP)--30.4 to 41.3 per cent.
2. Cost plus incentive fee (CPIF)--2.7 to 10.7 per cent.
3. Fixed price incentives (FPI)--9.7 to 10.7 per cent.

It is clear that many Air Force procurement levels were responding to the DoD trend of increasing the use of incentive-type contracts. Although the

²Katherine Johnsen, "Higher Incentive Rewards, Penalties Due," Aviation Week & Space Technology (June 3, 1963), 84-85.

figures quoted above indicate a positive trend away from cost plus fixed fee contracts, it is not clear whether or not the awards made were the same type of contracts with a new title. Many of the contract awards were for R&D study programs which simply required a level of engineering effort over a period of time. These contracts could have been readily converted from cost plus fixed fee to an incentive or firm fixed price contract without any significant changes in the contractors' performance.

TOWARD COMPETITION

An additional weakness which DoD attempted to correct involved contractor performance targets which were not in tune with the incentives. This was due primarily to inexperience of government negotiators and the need for much closer collaboration between technical and procurement personnel in defining performance objectives. Without an identification of performance objectives, the contractor under a CPIF award will not only be motivated to reduce his costs relative to the target cost, but also to obtain the highest possible target cost (the net effect of which would not lead to the lowest cost to the government). This led to the initiation of a program definition phase in which two or more contractors would compete with one another to define the program required for the procurement of operational systems. Thus, the combination of a competitive definition phase along with cost incentives could lead to the lowest possible final cost of system development.

The program definition phase, later to be called the contract definition phase (CDP), was instituted primarily as a first step in Defense Secretary

Robert McNamara's overall plan to acquire the technical building blocks to assure the feasibility of a project. After the project had been carefully defined the next step would be to eliminate any parallel efforts. In June, 1963, the first formal and comprehensive policy was issued as a DoD directive by Dr. Harold Brown, Director of Defense Research and Engineering (DDR&E).

This directive was a major milestone in the streamlining of defense contracts. Prior to its introduction, there was a general tendency to select contractors on the basis of a partnership arrangement with the government. The terms, configuration, design, and development were all negotiated within a sole-source environment. Thus, the immediate implication of a program definition phase was not only the elimination of vast expenditures on technically unfeasible or duplicative projects, but the establishment of a situation in which more than one contractor can competitively participate in the definition of major programs.

The trend has been to increase the use of price competition. In terms of the dollar value of prime military contracts awarded by DoD, 39.1, 43.4 and 44.4 per cent were awarded on the basis of price competition in fiscal years 1964, 1965 and 1966, respectively. The Air Force, major purchaser of complex weapons, took the lead in shifting toward competitive contracts. In 1961 less than 15 per cent of its contracts were competitive,³ but by 1965 this figure increased to 25.1 per cent.⁴

³Cecil Brownlow, "DoD Stressing Procurement Competition," Aviation Week & Space Technology (Mid-December, 1967), 16-21.

⁴Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), p. 3.

The emphasis on competition was put very clearly by Secretary Charles, who stated "Where there is competition there might be failure, and it is this risk of failure that causes a man or an organization to rise to the peak of his skills."⁵ Industry must imply from a statement such as this that it is not operating at the peak of its efficiency and that competition, although it has been a minimal part of defense procurement, will produce better results. In short, Defense Department procurement was shifting to ensure that the bidder delivers what he has promised to supply. If he does not, it will cost him, and with past performance being used increasingly as a factor in the evaluation of individual bids, it may be a long time before another Defense Department contract comes his way.

The program definition phase also opened the doors for a more widespread use of fixed price and incentive-type contracts.

TOWARD FIXED PRICE CONTRACTS

The use of systems engineering techniques provided a better technological base and definition of the total program requirements. When results of a program definition phase led to a reasonably firm program, the government could specify which components and subsystems (if not the entire system) could be obtained by fixed price contracts, with incentives to meet not only cost but schedule and performance requirements.

Of significant interest is the spiraling decrease in cost reimbursement contracts--from 36 per cent of DoD prime contract dollars in 1961 to 9.4 per

⁵ Robert H. Charles, "Effective Competition a Key to Government Procurement," Defense Industry Bulletin (October, 1965), 3-4.

cent in 1965. It has crept up slightly in fiscal 1966 and 1967 to 9.9 per cent but the trend is still downward. The slight increases in fiscal 1966 and 1967 can in all likelihood be attributed to the pressures of Vietnam procurements.

Table II provides a fiscal year breakout between the years 1958 and 1966, showing the distribution of awards by DoD, by fixed price and cost reimbursement-type contracts. The procurement of large defense systems changed rapidly from CPFF in a non-competitive environment through a competitive CPIF situation and then into a fixed price incentive firm competitive contract. This rapid transfer from CPFF to FPIF makes quantitative analysis of overall performance very difficult in comparing fixed price incentive contracts with cost plus incentive contracts.

This rapid transition from a cost reimbursement atmosphere to a fixed price incentive competitive atmosphere has been perhaps the most profound change in government procurement policy in two decades. Contractors were now required to compete during the contract definition phase to determine the best technical performance they could provide. In addition, they must compete in an environment which ensures this performance under severe penalties (in that the contractor must perform under a fixed price limitation).

TOWARD A NEW CONCEPT

With the competitive process of program definition well ingrained in the minds of both government and industry, development contracts for large weapon system acquisitions were negotiated in a competitive atmosphere with emphasis on promises of technical excellence. Since the system project office (SPO)

TABLE II

DISTRIBUTION OF DoD AWARDS
 (In Millions)

Type of Pricing Provision	FISCAL YEAR					
	1958	1959	1960	1961	1962	1963
TOTAL	\$22,162	\$22,873	\$21,182	\$22,857	\$25,780	\$26,225
FIXED PRICE TYPE (SUB-TOTAL)	13,389	13,520	12,160	13,243	15,667	17,013
Firm	6,168	7,498	6,645	7,211	9,795	10,886
Redeterminable	1,630	1,070	1,298	2,403	1,897	981
Incentive	4,253	3,508	2,879	2,553	3,096	4,137
Escalation	1,336	1,442	1,336	1,075	877	1,007
COST REIMBURSE- TYPE (SUB-TOTAL)	8,773	9,353	9,022	9,614	10,113	9,212
No Fee	616	686	466	466	595	621
Fixed Fee	7,363	7,836	7,803	8,362	8,384	5,439
Incentive Fee	703	741	672	724	1,061	3,061
Time & Materials	89	88	78	60	71	89

SOURCE: Cecil Brownlow, "DoD Stressing Procurement Competition,"
Aviation Week & Space Technology (Mid-December 1967), 16-21

awarded two or more contracts for definition, with equal funds for the performance of equal work, the resulting proposals promised higher levels of technical performance than would be the case in the absence of a competitive definition activity. Furthermore, during the contract definition phase (CDP) the SPO was able to point out areas in which the contractors' work might be deficient. This was possible because a single SPO was the recipient of inputs from all contractors, and could recognize subtle differences of technology at an early stage. The resulting contractor proposals generally met the minimum requirements, and furthermore, were more likely to be of equal quality.

Using a competitive program definition phase, the distinguishing feature in selecting a contractor was price, since the operational performance promises on development contracts were rarely reinforced by binding commitments. When performance promises were held binding, cost commitments were rarely enforced. In other words, performance promises may in fact have been met, but with increased costs. Thus, competitively awarded development contracts did not necessarily result in a minimum cost, because the contractors' bids were based on 1) expectations of future procurements for development, production, support, training, spares, etc., and 2) the possibility of negotiating favorable price changes. Contractors anticipating sequential awards on an incremental basis were prone to offer low bids for development.

Since experience on development contracts indicated that development costs represented only about 20 per cent of the total cost of putting the weapon system into operation, it appeared that additional contract innovations were necessary

to avoid "iceberg" procurement (80 per cent of weapon system cost undefined). In the development contract, the contractor was only required to provide cost estimates for production quantities and total operational field support of the weapon system. The government was therefore committed to a contractor who had competed during the CDP for only the development portion of the weapon system, and whose estimates for production and follow-on support were consistently overrun. In effect, the government was inducing contractors to "buy-in" during the competitive CDP for development, knowing that no substantial penalty would be imposed for overstating performance and understating cost, and that future business in a sole-source environment would result in a favorable financial position.

A further aggravation of the procurement process was the relatively uniform rate of profit earned by contractors, despite the wide variances in technical performance required by different contracts and the resources of defense contractors. This problem essentially arose from the negotiation of the usually larger follow-on production and support contracts in a sole-source environment. Although Air Force CPFF contracts were reduced from 50.6 per cent in 1961 to 10.4 per cent in 1965, the target prices for 74.9 per cent of the work in fiscal year 1965 were set in a non-competitive environment.⁶

The conclusions generally reached in analyses of competitive, development-only contracts, are that the contractors have a negative incentive to design and

⁶Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), p. 3.

manage for the lowest production and operating cost.⁷ The contractor could "get well" wherein a low costed R&D contract coupled with a production contract in a non-competitive environment would result in a reasonable profit.

Several real problems arise from this predicament. The additional time and expense required to choose another contractor for subsequent contracts would not only mean an extension of the delivery date of the operational system, but might also lead to additional development costs in bringing other contractors into a reasonably competitive position with the initial development contractor. Furthermore, the development and production phases overlap to a certain degree, making a clear point of transition difficult to define.

Therefore, the government, concerned not only with achieving a favorable price for research and development but also for the total program cost, needed a new idea for procurement.

THE TOTAL PACKAGE CONCEPT

The Air Force took the lead in introducing the notion of contracting for both development and a substantial portion of production and support at the same time. Their ultimate goal was to achieve the best product for the least price by negotiating the total program under meaningful competition such that the contractor could not "buy-in" during development and "get well" on the follow-on. The

⁷Ibid.

first public discussion of such a plan was presented in June, 1964 at an Air Force/Industry conference at Wright-Patterson AFB. Air Force Assistant Secretary Robert H. Charles (Installation and Logistics) presented a plan in which the contract target cost for the entire program would remain constant throughout the entire contract period, and would be established competitively at the outset of development or at the end of the contract definition phase.

The only exception to this cost freeze would be changes in the work itself. To reduce the probability of frequent changes in the work, the contract definition effort would be much more critical. In fact, accurate contract definition would be the foundation of the single contract procurement idea. Profit would be targeted initially, in a competition among at least three firms, and would be finally determined by the winning competitor instead of being administered as in past years. Secretary Charles believes in the American version of free enterprise, competition, and incentives, and says:

The cure lies in a return to the principle of a free competitive economy. Under such an economy, the producer prospers who is efficient in terms of creativity and management of resources. The inefficient producer does not, and he retires from that particular activity.⁸

Although the concept was initially called the "Charles Plan," it has since become known officially by the Air Force as the "Total Package Procurement Concept" (TPPC). Authors writing on the subject have called the concept "bundle bidding," "cradle to grave," "womb to tomb," and "single thread"; this report contributes the term "icebreaker" procurement.

⁸Robert H. Charles, "Remarks by Robert H. Charles," (Institute on Government Contracts, sponsored by the Southwestern Legal Foundation), p. 6.

In attempting to act like any buyer in the commercial market, the government, using the TPPC, could choose between competing products not on the basis of estimates, but of binding price commitments concerning the performance of operational equipment, including life cycle operating costs. This assumes that the concepts of a free economy (i. e., operating in a marketplace environment and subject to the laws of supply and demand) are applicable to the weapon acquisition process.⁹

The total package concept is based on the premise that if a system can be defined with reasonable accuracy, and if the major technologies of that system are in hand (leading to a straightforward job of engineering development), then competitive commitments concerning performance and price can be made. As conceived by the Air Force, procurement of a weapon system under the TPPC includes all anticipated development, production, and as much support as feasible, throughout its anticipated life. The "total package" contract would contain price and performance commitments at the outset of the acquisition phase.

The principal benefits anticipated under such a concept are as follows:¹⁰

1. Design and configuration discipline are tightened, both in the proposal specifications and the work under contract.
2. Unrealistic "salesmanship" and "buy-in" bidding are inhibited, as are overestimates of performance and underestimates of cost. These

⁹Robert H. Charles, Total Package Procurement Concept (February 18, 1966), p. 1.

¹⁰Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), pp. 3-5.

practices are encouraged when commitments are required on only a small part of the program, and result in performance disappointments, budget disruptions, funding reallocations, and program stretchouts or cancellations.

3. The contractor, committed to cost and performance levels for production units before detail design begins, has strong motivation to design initially for economical production and reliability and simplicity of maintenance. This should, among other things, minimize production redesign, reduce the need for subsequent value engineering redesign, and capitalize on new cost-reducing machine tools and fabrication techniques. It should produce not only lower costs on the first production units, but a lower take-off point on the production learning curve, thus benefiting every unit in the production run. In addition, since ground support equipment is included in the price of the total package, the contractor has a positive inducement not only to design and build such equipment economically, but to design the system itself so as to require less (or less expensive) ground equipment.
4. For the same reason as in (3) above, the contractor is motivated to obtain supplies and services from the most efficient sources. Approximately 50 per cent of the effort on prime weapon systems contracts is further subcontracted. In searching for efficient sources for this support work, prime contractors, already committed to cost and performance limits, will apply forces which compel efficiency--such as competition and incentives.

5. Competition is increased at the beginning, thereby decreasing the need for subsequent competitive reprocurement of components, with all the drawbacks that this entails. When a component has been originally built by or under the direction of a prime contractor and is then put out for competitive bidding, a risk concerning the integrity of the system as a whole is created, complete interchangeability of the component is threatened, and a difficult-enough logistics problem is further complicated by a new part and part number.
6. Commitments established in competition force the winner to be efficient. A natural desire to excel is transformed into a necessity by competition. The resulting efficiency benefits not only the buyer, but the seller. He is then in a better position to compete for the next round of business, and for business in other markets.
7. The government is able to make a choice between competing contractors based not on mere estimates, but on binding commitments concerning the performance and price of what is really required--operational equipment.

The views of Secretary Charles are that any program which goes through contract definition is at least a candidate for total package procurement.¹¹ Furthermore, every major new program is now required to go through a contract definition phase unless an explicit waiver is received from DDR&E. In April of 1965, the total package procurement was initiated for trial on the C-5A

¹¹ Robert H. Charles, "Remarks by Robert H. Charles," (Institute on Government Contracts sponsored by the Southwestern Legal Foundation), pp. 1-13.

by approval of the Office of Secretary of Defense (OSD). The contracts awarded to date under the total package concept are of long duration (several years) and few in number. The concept has only been applied for three years. Its full impact on major weapon system acquisitions may not be realized or even determined for several years; nevertheless, an evaluation of the concept can be made, and its results must be measured against its declared advantages.

FUTURE OF TPPC

Additional Air Force programs earmarked for contract definition and total package procurement are the Mark II Avionics; Maverick; 2AGM65-A, air-to-surface missile; Improved Third Stage for Minuteman; AWACS; AWADS; Mark 18 Reentry System; solid rocket motor for the Titan 3D launch system; 418 Ryukyu air defense system; and the 407L tactical air control system.

The Navy has adopted the total package concept for its fast-deployment logistics ship (FDL) competition, and had essentially a total package in 1964 when it awarded the A-7A Attack Fighter/Bomber contract. The army awarded a modified total package contract for the Advanced Aerial Fire Support System (AAFSS), and the Lightweight Observation Helicopter Avionics Package (LOHAP).

III. ELEMENTS OF THE TOTAL PACKAGE PROCUREMENT CONCEPT

To the uninitiated, the fact that a concept has been developed to define, procure, and manage a major weapon system, from program initiation through its operational life, in a competitive environment which ensures that performance requirements are tied to definitive cost commitments, does not appear to have profound implications. The impact of such a simple statement is not readily understood unless one fully appreciates the sophistication inherent in the complex weapon system acquisition process.

This acquisition process has been guided by long-standing DoD practices which are reflected in the myriad service and government agency regulations, DoD directives, armed services procurement regulations, military specifications, and system manuals for the guidance of activities leading to and through procurement. All of these documents have been generated to guide the acquisition and operation of a typical major weapon system by means of the sequential contractor approach. New weapon system procurements involved separate negotiations for development, follow-on production, training, spares, support and field services.

The advent of a new procurement technique has forced complementary changes in planning, scientific management, budgets, and systems engineering techniques with a long-standing past. Therefore, before initiating the total package procurement concept (TPPC) the government had to consider the effects on the following phases of standard procurement:

1. pre-contract activity leading to the generation of a contractor request for proposal (RFP);
2. contractor and government activity during the contract definition phase (CDP);
3. development of a model contract during the pre-acquisition phase;
4. considerations of a source selection and evaluation committee; and
5. management and monitoring practices to be applied during development and production of the operational system.

PRE-CONTRACT ACTIVITY

Pre-contract activity is defined as those government and contractor activities engaged in prior to the receipt of a government RFP for competing in the contract definition phase. This phase is described in DoD Directive 3200.⁹¹ as the "concept formulation" period. During this period, the government is engaged in system studies to determine the cost effectiveness of fielding various types of weapon systems. Contractor agencies are engaged in certain funded studies in advanced research and development, including experimental hardware, to determine the feasibility of employing various concepts in the production of operational hardware. The contractor, anticipating a favorable competitive position for the contract definition phase to follow, will usually supplement the concept formulation effort with company funds to gain a competitive advantage for the CDP.

¹United States Department of Defense, Initiation of Engineering and Operational Systems Development, Directive Number 3200.9, July 1, 1965.

During this phase, the Defense Department determines the nature of the weapon system to be deployed. Not only must the overall performance requirements of the system be determined, but the force structure must be analyzed to determine the quantities which must be deployed. This period is characterized primarily by the generation of engineering data rather than experimental effort. The mission of the proposed weapon system and performance envelopes must be defined, and the technology required to meet this mission must be sufficiently well in hand. A review and thorough trade-off analysis of the several research activities by the Department of Defense will result in selection of the best technical approaches.

Once the technical approach has been determined, the overall cost effectiveness of the proposed system must appear favorable in relation to competing weapons, to define the nation's defensive structure. In addition, preliminary costs and schedule estimates must be made, and must be credible and acceptable in light of operational requirement dates and force structure requirements.

The most important aspects of the concept formulation stage are:

1. The mission of the system, whether it be strategic or support, must be well defined.
2. The technology required to meet the system specification must not exceed, in quantitative performance, that which can be demonstrated either in development or laboratory form².

² Ibid.

A necessary adjunct to the establishment of system performance requirements, especially in the case of strategic and tactical weapon systems, must be a high-confidence digest of reliable intelligence sources revealing the capability that must be defeated by the weapon system.

Conditional DoD approval of the RFP for the program requirements indicates that the mission requirement and technical performance have been specified within the state of the art, and that the using activity has the capability of fielding the system.

In the total package concept, the formulation stage takes on increased importance because the RFP must not only specify performance and schedule requirements for the development portion of the program, but must also define operational quantities and support requirements so that a life-cycle cost of operating the system can be prepared by contractors competing for the next stage of procurement. Thus, the conditional approval emphasizes the need for involvement of the using command in the formulation stage.

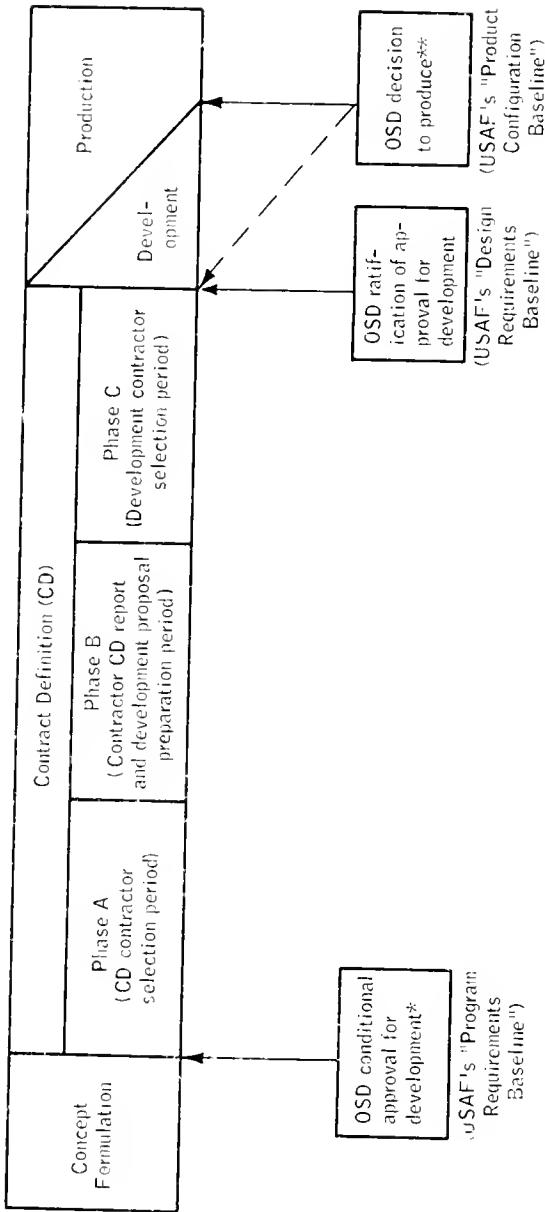
The RFP is then issued to defense contractors whose past performance has demonstrated a capability of developing the required system and who have a desire to bid. The required response of government contractors is to convince the government that they have the necessary resources and technology to conduct a contract definition phase and the follow-on development and production. Since the award will cover only CDP on a firm fixed price, only estimates for development and production need be provided.

CONTRACT DEFINITION

During the contract definition phase, both the government and contractor are required to amass great manpower and resources to be responsive to the requirements of the RFP and subsequent selection activities. Figure 1 shows the relationship of the concept definition stage to other stages in the procurement process. If the government has already ascertained that only two or three contractors have the capability to develop the weapon system, Phase A of contract definition may be waived. Otherwise, contractors submitting proposals in response to the initial RFP are evaluated relative to their development and production capability, and a selection is made of two or more contractors to participate in contract definition of the system.

The total package concept, as conceived by the Air Force, envisions that all anticipated development, production, and as much support as possible be procured as one total package and incorporated into one contract containing price and performance commitments at the completion of contract definition. Therefore, the product of contract definition must be a system defined with a high degree of detailed accuracy, such that a definitive performance specification and model contract can be developed. To assess program risks, a fixed price must be established; therefore, the technology must be demonstrated to be well in hand. Without obtaining a fixed price, the total package concept cannot be applied.

Unless a waiver is received by DDR&E, a competitive contract definition phase must be awarded on all systems and subsystem developments requiring



- * Note that this conditional approval is for full-scale development and production under the total package concept, not merely for contract definition.*
- ** The production decision, for at least initial production quantities and/or long-lead-time items, may be made concurrently with the development decision; hence, the dotted line.*

88-1804

FIGURE I

THE TERMS ASSOCIATED WITH CONTRACT DEFINITION (CD)
(per 7-1/65 version of DoD Directive 3200.9)

total cumulative RDT&E financing in excess of \$25 million or total production in excess of \$100 million.³ Since the total package concept requires a contractor to make a firm production commitment, only those contractors having production capabilities can be awarded a total package contract. Contract definition will generally be conducted as a DoD financed effort by two or more contractors under fixed price contracts. DoD direction requires each contractor to be fully compensated under the terms of his contract for his proposed work. In addition, any action suggesting cost sharing, such as prior announcement of funds available for contract definition, should be avoided.⁴

The overall objective of the contract definition phase is to determine whether the conditional decision to proceed with engineering development should be ratified. The ultimate goal of contract definition is the establishment of achievable performance specifications, backed by a firm fixed price or fully structured incentive proposal of engineering development. Included within these overall objectives are the following specific objectives:⁵

1. provide a basis for firm fixed price or fully structured incentive contract for engineering development;
2. establish firm and realistic performance specifications;
3. precisely define interfaces and responsibility;
4. identify high-risk areas;
5. verify technical approaches;

³ Ibid., p. 4.

⁴ Ibid., p. 7.

⁵ Ibid., pp. 2-3.

6. establish firm and realistic schedules and cost estimates for engineering development (including production engineering, facilities, construction, and production hardware that will be funded during engineering development because of concurrency considerations); and
7. establish schedules and cost estimates for planning purposes for the total project (including production, operation, and maintenance).

Item (7) indicates that a firm commitment to the total production and support of a program is not an inherent requirement in the guidelines for conducting contract definition per DoD directive. Therefore, it became necessary for the total package contract definition work statement to define a requirement for firm prices or targets on production and operational support in addition to development, and in many cases, guarantees of operating costs as well.

From the time of selection of the contract definition contractors to the final award for development, the RFP may undergo a multitude of changes to be concurrent with the desired responses of DoD. To ensure the maximum degree of comparability between the competitive proposals resulting from the CD, the RFP is usually prepared in three parts:

1. A letter of transmittal identifies the type of procurement method contemplated. The letter outlines the "total package" requirements, and contains many unique clauses not part of standard DoD contracts.
2. A work statement outlines performance requirements and schedules, and contains a multitude of exhibits and regulations with which the contractor must comply.

3. A model contract identifies all the contractual terms that must be complied with by the contractor. It provides a common frame of reference upon which source selection can be made. Among other things, the model contract typically specifies cost ceilings, fee limits and sharing ratios.

By definition, the CD period will require no longer than 6 months (with 3 to 4 months being the norm). An award decision will be made within 4-1/2 months of receipt of the contractors' development and production proposals.⁶ Upon receipt of the contractors' CD proposals, the government is required to maintain competition until negotiations for a satisfactory model contract have progressed (in the judgment of the System Program Office) to a point where competition is no longer required. During this time, the government continues to fund the CD contractors for the maintenance of key personnel and final contract negotiation.

Contractor Activity

To submit a responsible total-package proposal, the contractor must perform a great deal more analysis and a more detailed projection of cost figures than for development-only contracts. Confidence in his total commitment requires that a contractor engage in preliminary design activities and perhaps prototype development of critical components or subsystems. Therefore, activities performed during the development portion of previous contracts may now have to be accomplished during the CD phase.

⁶ Ibid., p. 9

Government Activity

In generating a work statement containing performance requirements tied to firm and binding cost commitments, the government must be sure to include all elements of the work and all performance requirements necessary to field the system. The work statement must not only satisfy the approved mission of the weapon system, but must also provide a firm commitment by the government to meet its responsibilities by ensuring that the using command has the capability to receive the system into its force structure in the proper quantities. Thus, both the contractor and government are required to "think through" the program more than ever before to determine that:

1. the technological building blocks are available,
2. the weapon system development time is consistent with operational requirements,
3. the mission is a viable one, not subject to many iterations through development, and
4. the using command will be able to receive the weapon system into the force structure in a timely fashion.

These are all necessary objectives that must be accomplished during the CD phase and prior to the award of a definitive development and production contract. Not only must the contractor recruit vast resources to be responsive to such total commitments, but the government must also summon its manpower to evaluate properly the contractors' proposals, while still maintaining a competitive environment. In this environment, the evaluation

board can commit each contractor to a firm, binding, model contract prior to submittal of these contracts. It also makes recommendations to a source selection committee for the final award decision.

MODEL CONTRACT DEVELOPMENT

General

Realizing that contractors have committed resources for long periods of time under the highest degree of competition, the Air Force recognized that special contract provisions must be considered in awarding contracts under the total package concept. Also recognizing that the existing procurement regulations were not specifically tailored for total package procurement, unofficial guidelines were established in a document prepared by the Department of the Air Force.⁷ Throughout this chapter, references to requirements of TPPC contracts are based on these guidelines.

To ensure attainment of the cost and schedule commitments proposed by the contractor in the CD phase, the contracts executed must establish these characteristics as firm obligations rather than as goals. This objective precludes the use of a cost-type contract. Whether the contract will be a firm fixed price (FFP) or a fixed price incentive firm (FPIF) is determined on a case-by-case basis after consideration of the degree of risk inherent in the program, fully realizing that the contractor is required to commit to firm production costs prior to the full-scale development of the

⁷ Total Package Procurement Concept, A Report Prepared by the Department of the Air Force, (May 10, 1966), pp. 1-35.

system. An FPI contract is considered preferable for two reasons: 1) the uncertainty of the program commitments may result in competitors allowing large reserves, and 2) an incentive contract induces the contractor to accept more risk at the appeal of greater profits.

When quantitative requirements for production are expected to be revised during the course of a program, it may not be judicious to cover those aspects of production, support, and training as a firm contract requirement. Instead, they may be better defined in the work statement as "priced options." These priced options do not compromise the total package concept, since the government need only exercise the options to remain within the precepts of the total package procurement. In cases of greater uncertainty, several options may be established during the contract definition phase to provide the government with greater flexibility in structuring a definitive contract package work statement with a firm cost commitment on the part of the contractor. On the other hand, such uncertainty reflected in the CD work statement could lead the contractor to believe that the program is not well thought through, and that it may be subject to later contract changes, thus opening the procurement to renegotiation subsequent to an award decision.

In establishing production options, the priced option increments may clearly be individually more expensive; therefore, each increment must reflect a minimum quantity to ensure that the production facilities are on hand and that the quantities provide for economical purchasing and handling.

However, if the total anticipated production commitment might equal or exceed the contract, an option-increment consideration is given to establishing the entire combined amount as the basic contract requirement. In this case, the savings resulting from economies of scale should be weighed against the government's liability of termination costs should the quantitative requirement subsequently be decreased.

Special Provisions

Having established the scope of contract requirements (i. e., development performance, production quantities, training support, priced options, and formulas for spare parts), certain provisions and procedures must be considered to:

1. maintain the target prices and schedules during the course of the program;
2. provide reasonable protection for the contractor against cost increases that are beyond his control; and
3. encourage the contractor, where economically possible, to improve the price performance and schedule commitments.

Target Prices and Schedules

Contract Changes. The most critical of all areas in the maintenance of target prices is contract changes. Changes to a defined contract reopen the contract for negotiation, thus reverting to a sole-source environment. The first attempt at minimizing changes in total package procurement is to express what the government wants, not in terms of

details or parts specifications, but in terms of operational performance. This will eliminate the need for changes in the contract if a drawing or detailed specification is changed.

Contractors can be provided a negative incentive to initiate change by restricting profit on changes over and above a certain aggregate percentage amount.⁸ Thus, the contractor can be expected to resist rather than encourage changes. Furthermore, to avoid administrative expenses for pricing minor change proposals, a minimum dollar limit can be established below which individual changes will not be priced and will not result in adjustment of the target cost, profit, or ceiling price, either up or down.

Schedule Changes. A second area which can result in extensive renegotiations is deviation from the initially targeted production schedule. Typically, production has been delivered at a constant rate, with variations existing only during the buildup and tailoff period. This is not necessarily the most economical production scheme, since the effect of a learning curve is to automatically provide for increased production. In any event, changes to the production delivery schedule, whether program stretchout or compression, will generally lead to renegotiation in a sole-source environment. Therefore, the total package concept establishes definite alternate target costs for variations from the initially determined delivery schedule. Failure of a contractor

⁸ It has been past practice to negotiate changes at approximately the same profit percentage as was negotiated on the basic contract.

to meet the particular delivery schedules has generally widespread implications, since extra contractual forces have been put in motion to integrate with the system at an expected time of delivery. In the past, no firm legal action has been taken by DoD to recover damages in the form of expenditures resulting from untimely delivery. One recent method of determining the value of delinquent delivery is to consider the cost of obtaining comparable performance from existing systems over the period of delinquent delivery. In this manner, reasonable assessments of potential damage can be derived at the outset of the program, and can be included in the contract as liquidated damages for late delivery.

Termination. A third occurrence that would create enormous areas of renegotiation would be contract termination in the early years of a program. To limit this enlarged area of renegotiation, a price similar to the ceiling price, established on a government obligation per year, should be negotiated into the basic contract.

Correction of Deficiencies. In addition to maintaining price commitments, it is equally important to maintain performance commitments. In the past, once items were accepted by inspection and delivered they were considered to meet the contract requirements with the exception of some latent defects or gross mistakes that necessarily amounted to fraud. A clause requiring the contractor to correct any deficiencies was not used effectively. Recent major weapon acquisition contracts

have included a correction-of-deficiencies clause which creates a type of warranty to ensure compliance with the contract requirements relating to operational performance. The same type of clause must be applied to the total package concept.

When operational performance requirements on production units are established at the outset of a development program, the implementation of such a clause becomes much more difficult. Therefore, in total package procurement where it can readily be expected that operational units will be delivered concurrently or during the tail-end of the development test program, extensions of the application of such a warranty must be included. More important, the clause should provide a definite procedure for the execution of a decision after a defect is discovered--whether the defect should be corrected in whole, in part, or not at all. The ultimate decision rests with the Department of Defense. Moreover, in the case of less-than-complete correction, it should be accompanied by a reduction in target cost, price, and ceiling.

Protection Against Unreasonable Risks

The total package concept increases the risk to the contractor in two ways: 1) a long-term resource commitment to form production contracts without full-scale development represents a higher degree of risk than with development-only contracts, and 2) a firm fixed price may be subject to economic fluctuations beyond the contractor's control.

For these reasons, certain considerations must be given to contractors on total package contracts.

First, the contract must be a firm fixed price incentive contract to ensure that if the target cost is exceeded, the contractor will not incur real loss. A fee-reducing feature must also be included, and the ceiling price should be high enough above target price to allow for development and production contingencies without invalidating the price commitment. The incentive share must be high enough to encourage efficiency without imposing unreasonable risk.

Second, to protect the contract against unforeseeable changes in the national economy (as reflected in the appropriate Bureau of Labor standard indices), it must contain clauses to permit a change in the target price for economic escalation. This would include cost deviations arising from changes in the federal statute governing work conditions and fringe benefits.

Motivation To Exceed Commitment

The longevity provided by the total package concept increases the opportunity for a contractor to take advantage of technological developments occurring during the program's duration. Thus, an appropriate cost incentive should encourage a contractor to seize these opportunities to reduce the cost to the government and therefore increase his profit. A steep cost sharing may force competitors to include contingency

factors in their target cost bids, which later prove unnecessary. Therefore, because a fixed incentive formula does not adequately motivate the contractor during development to produce highest quality at least costs, the total package concept introduced a flexible incentive. This incentive permits the contractor to voluntarily and unilaterally adjust the sharing ratio during the performance of the contract. In this way, if he can reduce costs he will be able to generate higher profits by increasing his share in the cost overrun. This flexible cost incentive is explained in Appendix F.

A second motivation for the contractor to exceed his commitments is by rewarding above-requirement performance. In submitting a bid, a contractor will set forth the highest performance standard that he is confident of obtaining. The contract award will incorporate the proposed standards of the winning competitor as the minimum acceptable contractual requirement, and the contractor will be required to meet these standards under the correction-of-deficiencies clause.

Nevertheless, it is desirable to incorporate incentives for achieving performance over and above that specified in the contract, thus allowing the contractor to achieve the greatest latitude in increasing his productivity per dollar. The actual amount of such performance rewards must be determined on the basis of the value to the Department of Defense of any cost effectiveness increase over the anticipated total utilization during the period of first-line use of the system. The

performance reward must be equal to an amount derived by applying the contractor's overrun/underrun share to this predicted value.

In the case of a transportation system that will produce 28 billion ton miles at \$.05 per ton mile on the basis of the contract performance requirements, a reduction in the cost per ton mile of 2 per cent (or 1/10 of one cent) would be worth \$28 million to DoD. This performance increase is desirable if it can be obtained for a total cost to the government of anything less than \$28 million. This 28-million-dollar figure must cover both the government's share of the increased development and production costs, and the contractor's performance reward. The contractor will be motivated to attain this performance increase only if his share of the increased costs of development and production is less than his performance reward. A simple equation is derived by treating "less than" as "equal to". Thus, the Department of Defense desires the government share of increased costs (IC_g) plus performance reward (PR) to equal value (V), while the contractor desires his share in increased costs (IC_c) to equal the performance reward (PR). As explained by the Department of the Air Force:

If value (V) is 28 million dollars and the Incentive Share is 85/15, the government is willing to pay a total of 28 million dollars in increased costs plus performance reward, or

$$.85 IC + PR = 28M.$$

The contractor is willing to provide the increased performance, if his performance reward (PR) is equal to his share in increased costs (IC), or

$$.15 IC = PR$$

Substitution, to make government and contractor trade-offs identical, results in PR being equal to 4.2 million, or the contractor share in increased costs multiplied by the value of the increased performance.⁹

In the case of a flexible cost incentive contract, the performance reward should initially be established by application of the initial cost share specified in the formula. Automatic adjustments to the performance reward must be made as the cost share varies, to maintain the trade-off motivation balance originally established. This can be accomplished by multiplying the original performance reward by the new composite cost share, and dividing by the initial cost share to establish the new performance reward level.

SOURCE SELECTION

Just as in major procurement of the past, procurement under the TPPC uses a source evaluation board (SEB) at the service level to:

1. consider the proposals against the evaluation factors identified in the RFP;
2. score each proposal and prepare concise narratives supporting the scoring and describing the strong and weak points of each proposal; and

⁹ Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), pp. 21-22.

3. make recommendations to the source selection committee.¹⁰

The SEB activity takes place during Phase C of contract definition. During this phase, the government attempts intercontractor transfusion of technical information to provide as common a base as possible for evaluation. Having achieved a reasonable baseline, the contractors subsequently enter into negotiations on price for the changes. On programs for which contractual requirements can be expressed in detail in the RFP, it is quite clear that price competition is a major factor in source selection. In theory, programs proposed under total package are generally not in the realm of price competition, since the RFP generally states the requirements of the program in terms of overall performance rather than in detail. In most advanced weapon systems, performance standing by itself is more important than price alone, but the two factors must be related. This is accomplished by basing the source selection on the cost effectiveness of the anticipated operational quantity in an operational environment, over a period of time equal to the anticipated first-line utilization of the system.¹¹

It is not clear whether this evaluation is performed by the SEB; nevertheless, the recommendations of the SEB are forwarded to a source selection committee, at which time a cost-effective evaluation can be made. It must be pointed out that total package contracting does not require that awards be made to the low bidder. Instead, awards must be made on an integrated, meaningful basis, considering the performance and price commitments made by the competitors.

¹⁰ Proposed Evaluation and Source Selection, DoD Directive 4105.62, April 6, 1965.

¹¹ Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), p. 7.

DEVELOPMENT ADMINISTRATION

In previous cost reimbursement contracts, the government was a senior partner with the contractor. Cost, performance, and schedules were goals to be met through daily negotiation under many controls and regulations. The advent of fixed price contracts, and in particular the TPPC, alleviates the need for this partnership and will lead to the relaxation or even elimination of controls. These controls are further minimized when firm contractual commitments for price, performance, and delivery of operational equipment are made by contractors. Furthermore, if the contract is structured such that cost and performance incentives motivate the contractor to reduce costs and improve performance, the contractor has assumed total responsibility for the benefit of the government.

These two objectives--relaxation of controls and total contractor responsibility--must not be left in a complete laissez-faire situation, for the ultimate responsibility of DoD is to field a weapon system that will reliably provide for the national security. To wait for the end day and find disaster would not only be a waste of public funds, but a threat to national security. Therefore, a unique balance must be met in generating total responsibility and relaxation clauses within the total package concept. Contractual commitments must be weighed against the cost of government control and the potential for increased program costs, technical deficiencies, and slippages arising from government interference in the program management.¹²

¹²Ibid., p. 23.

IV. TPPC APPLICATION AND RESULTS

This chapter surveys the underlying concepts and results of total package procurement. It examines the basic premise and philosophy upon which the concept was born and describes the atmosphere existing prior to and during contract definition. Implementation of the concept is analyzed for the three programs selected for study. In examining the elements of total package procurement during program implementation, considerable emphasis is placed on anticipated advantages described in the interview guide (Appendix A). The aim of this analysis is to objectively define a consensus of those interviewed concerning the performance of the total package concept.

Identification of specific interviewees, and in some cases of specific programs, has been intentionally obscured to protect the source of the information received during the interviews. Where necessary, references to published materials on a particular subject will be included. Separate analysis of individual elements of total package procurement is not readily made, since the elements are mutually dependent. Therefore, in many cases collective considerations were required to determine the effects of the TPPC on the nature of Air Force defense procurements.

The full impact of this concept may not be realized for many years. The final cost picture of defense contracts is not usually determined until many months after the contracted effort has been completed. In total package contracts, the period of performance is significantly greater than in development-only

contracts. This results in a more complex model contract, and therefore an extension of the post-contract activity that ultimately determines the contractor's final financial position on a program. Evaluation of the performance of TPPC contracts cannot be delayed until such a late date. Each program must be evaluated continuously so that corrective measures can be incorporated in other weapon system TPPC contracts. This chapter devotes itself to this end.

This study is limited to three Air Force contracts because they are the only ones to be awarded with a contract definition phase (CDP), a basic and major aspect of the total procurement concept, and because they are well into development.

BASIC PREMISE

As mentioned in the previous chapter, the TPFC is an attempt to return to the fundamental aspects of free enterprise in an American market; i. e., the freedom to compete and the freedom to prosper in an economy controlled by the basic laws of supply and demand.

The view that a free enterprise market system in a competitive environment is the solution to the acquisition of major weapon systems is unfortunate. It has been strongly argued that a market system for the acquisition of weapon systems does not now, nor can it ever, exist. This conclusion is supported by four conditions typical of the development of weapon systems:¹

¹Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process: An Economic Analysis, p. 57.

1. Private financing of the development of weapon systems is virtually impossible because of the large expenditures required.
2. Private investment would be subject to the risks of obsolescence, changes in strategic planning, government policy, and technical difficulties.
3. Industry is unable to determine the product characteristics desired by the government.
4. The government, generally the only buyer, has the bargaining power of a monopsonist (single buyer); therefore, the seller can hardly determine a price that would correspond to a commercial market system.

In theory, economists can easily predict the consequences of a monopsony:²

1. Prices paid by the buyer will be less than if competition between buyers existed.
2. Sellers will not have a given demand, but will encounter specific prices set or bargaining offers made by the buyer.
3. If the supply curve is other than perfectly elastic, the quantities bought will be different from those which would be bought were there many buyers.
4. The buyer will include in his purchase plans the influence of the relationship between costs and output of the supplier.

This classical characterization of a monopsonist does not apply entirely in the government. First, the demand for a system is established on other than economic grounds; e.g., the requirements for national security. The buyer

²How Sick is the Defense Industry?, Arthur D. Little, Inc., July 12, 1963, p. 27.

generally decides when and what kind of new weapon system is needed, and takes the initiative on new products with a fixed demand. The buyer has one goal: to acquire the products at a minimum cost. In addition, the buyer and seller agree on the purchase before the product even exists. The government pays the development costs before it knows what the ultimate performance of the product or its desirability relative to other products will be. Furthermore, the government can change, reduce, or cancel the project before it is ever completed.

It is therefore apparent that the illusion of weapon system acquisition being conducted in the American version of free enterprise assumes a complete market system, which is impossible and as undesirable to our society as a monopoly, for which firm anti-trust regulations have been established. A market system should decentralize decisions on what to produce and what the price should be among the many buyers and sellers. An economic situation in which there is a single buyer and many sellers, such as exists between the government and the defense industry, must therefore be considered a non-market.

The existing world cannot maintain perfect competition. Therefore, one must strive to achieve a workable competition. It is this "workable competition" existing among defense contractors that establishes price--not in a market atmosphere, but by government administrative devices and vetoes associated with the regulations governing the weapons acquisition process. However, some manifestations of a market process do exist between the government and the sellers, since without them our defense capabilities would decay.

Several agencies, regulations, and rules have been set up to regulate the conduct of both government and suppliers in this non-market. The principal instrument through which the DoD strives to achieve its procurement is the Armed Services Procurement Regulation (ASPR). This basic regulation for defense procurement is supplemented by renegotiation boards, government accounting offices, local Air Force auditors, government-employed technical direction, and numerous procurement directives and manuals. In this non-market system, free enterprise introduces 1) the promise of high profits for defense contracting through incentives; 2) more freedom from government supervision; 3) a decrease in concentration ratios of the large defense industries by offering a larger share for smaller firms; and 4) a promotion of efficiency through performance incentives. This synthetic market system is governed by regulations and agencies essential to maintain an adequate defense base with competition. However, a commercial market system does not exist, since the market itself is non-existent.

Increasing the extent of competition in the present non-market system, as required by the total package concept, requires that 1) incentives are in fact working to promote the promise of greater profits to the contractor, and 2) the agencies and regulations governing the performance of contractors must be modified and/or removed.

WEAPON ACQUISITION PROCESS

The foregoing discussion assumes that the weapon selection process is clearly defined and can be determined with certainty. TPPC assumes an

additional basic premise--that through the use of a contract definition phase, the performance requirements of a system can be defined and contracted for with a commitment for production at the outset of development.

A brief examination of the weapons decision process appears to be appropriate. When Secretary of Defense Robert McNamara assumed his position, he initiated a drastic overhaul of the decision-making process. His administration was marked by an increased sensitivity to cost-effectiveness, and perhaps reflected a rather general increased consciousness of systems analysis, think groups, and centralized decision making and planning. None of these techniques, however, have removed the burden of decision making from the people in defense management.

The generation of military requirements in the weapon acquisition process is extremely complex, involving more or less unpredictable factors known as "people". The ultimate rational decision depends on subjective probability and value measurements. Even though these may be systematically processed through a computer, they can still yield a variety of answers, depending upon the assigned measures of the decision maker. The various veto procedures in the administrative decision process do not result in the same intermediate or final decisions in weapon selection. The decision-influencing groups are faced with a complexity of information and with limited knowledge; furthermore, each is represented by multiple motivations that might influence the decisions.

Perhaps the three basic criteria in determining the desirability or value of a prospective military system are 1) existence of a legitimate mission

requirement, 2) technical feasibility, and 3) economic feasibility. Although considerable improvement has been achieved in determining the value and possible outcomes of each of the above in an environment of uncertainty, the judgments and motivations of the decision maker still remain. These judgments and motivations are especially sensitive to the economic well-being of the nation and the assessment of ambiguous enemy threats--particularly in the case of a decision to field a strategic weapon system based on conflicting intelligence information to which those involved in decisions have only limited access.

The total package procurement concept assumes a certain amount of constancy in the economics of the country, a limited and defined technical uncertainty of the project, and an accurate projection of the military requirement or threat. Fairly accurate forecasts of the weapon system design criteria must be made to field a viable system with a reasonable economic life. It is not clear that such forecasts can be made with sufficient accuracy to preclude changes or the termination of weapon system development. Lack of resources, a change in assessment of the threat, and armed conflicts such as Vietnam (which arise during the development of a major weapon system) can severely alter the economic criteria upon which a selection was made. For instance, the Mark 17 program was cancelled after almost two years of development with R&D cost growth well beyond the initial target cost.

The criteria of a valid mission requirement and technical and economic feasibility cannot be rigorously applied to the total military effort, but only to deliberately and somewhat arbitrarily isolated parts of it. These criteria are

difficult to test accurately in the early stages of weapon system development; therefore, there will continue to be doctrinal controversy and recourse to authority in the selection of military weapons. This is particularly true in peacetime, when the weapon types are usually selected against vague national and military objectives and theaters of operation, leading to the establishment of subsidiary service missions for large weapon system acquisitions which are difficult to define accurately and precisely. A major strategic weapon system selection decision made during peacetime is highly unlikely to last the duration of development and operational fielding. The various weapon systems being developed are an outgrowth of the specific contingencies resulting from war plans. Experience has shown that contingency plans are not very good for specifics, since we are dealing with a perverse enemy.

The decision maker for the selection of large weapon systems is also responsible for national security; therefore, he must not abrogate his authority to change the decision in view of new information. In fact, he must contract for those weapon systems in an environment that contemplates change, with the full expectation that such changes will alter the initial premises upon which the contract was awarded. In negotiating changes of this type, it must be made clear that they do not reflect an inadequate definition of a program, but reflect those measures necessary to ensure the operational mission success of the system.

SELECTION OF COMPETITORS

Among the several qualifications required to bid on TPPC contracts, a contractor must not only have the capability of performing the research and development work but also of providing the follow-on production and logistic support. In addition, he must be willing to assume a greater risk in the cost outcome of the program for a promise of greater profits. A contractor must also have demonstrated reputable past performance on defense contracts. This qualification is verified by a new procedure which uses a central information file maintained by the Department of Defense. This file includes contractor performance evaluation reports prepared at specific intervals by the government program manager for each of the contracts on which the contractor performs.

The selection of contractors for competitive weapon system programs is not as profound as it may appear. Early government assessment of the defense industry indicated that only three airframe and two engine contractors had the technology and the resources necessary to compete for the C-5A program. In the case of the Mark 17, although close to forty contractors or associations of contractors attended the bidders conference for contract definition, only fourteen actually requested RFPs. Only three of these contractors responded to the RFP and one contractor subsequently withdrew his bid. Only three contractors proposed for the CD phase for the SRAM program.

Although there may be surprises for future weapon system acquisitions as to which contractors may bid on a particular defense program, it was common knowledge in the aerospace defense industry who would be submitting bids for

contract definition in the cases studied. The ultimate contract awards went to Divisions of firms which did the majority of their defense business with the Air Force. Close to 70 per cent of DoD prime contract awards go to the top 100 corporations in terms of dollar sales, but the capability to develop specific types of weapon systems is essentially limited to two or three competitors. In 1966, firms directly associated with the aerospace industry received more than \$14 billion of the \$21.4 billion in procurement funds awarded the top 100 Defense Department contractors. Total Defense Department awards for the year amounted to \$33.5 billion--a \$9.3 billion gain over the previous year (reflecting the increased Pentagon spending spirals touched off by the war in Vietnam.)³ A three-year comparison of Lockheed, Boeing, and Avco defense award positions is shown in Table III.

Not only will the specialized technology and increased resources required limit the number of contractors competing for TPPC contracts, but additional reduction will result from a higher concentration ratio of TPPC contractors due to the amount of company funding required to effectively compete in the CDP. The Vice President of Government Contracts at The Boeing Company, Howard W. Neffner, notes that the number of companies engaged solely in government contracting and capable of developing major weapon systems continues to diminish in the light of the evolutionary development of TPPC.⁴

³"Aerospace Firms Lead DoD Contractors," Aviation Week & Space Technology (December 5, 1966), 29.

⁴Howard W. Neffner, "New Methods of Large Systems Procurement," address delivered at the NSIA Procurement Symposium, Washington, D.C., September 28, 1967.

TABLE III
DoD AWARDS*

Contractor	Relative Position			Total Awards (millions of dollars)			Per Cent of Total		
	1965	1966	1967	1965	1966	1967	1965	1966	1967
Lockheed	1	1	3	1,705	1,531	1,807	7.1	4.6	4.6
The Boeing Co.	8	5	6	583	915	912	2.4	2.7	2.3
Avco Corp.	21	12	16	234	506	449	1.0	1.5	1.1
Total DoD	--	--	--	24,178	33,532	39,219	100	100	100

* Years represent fiscal years

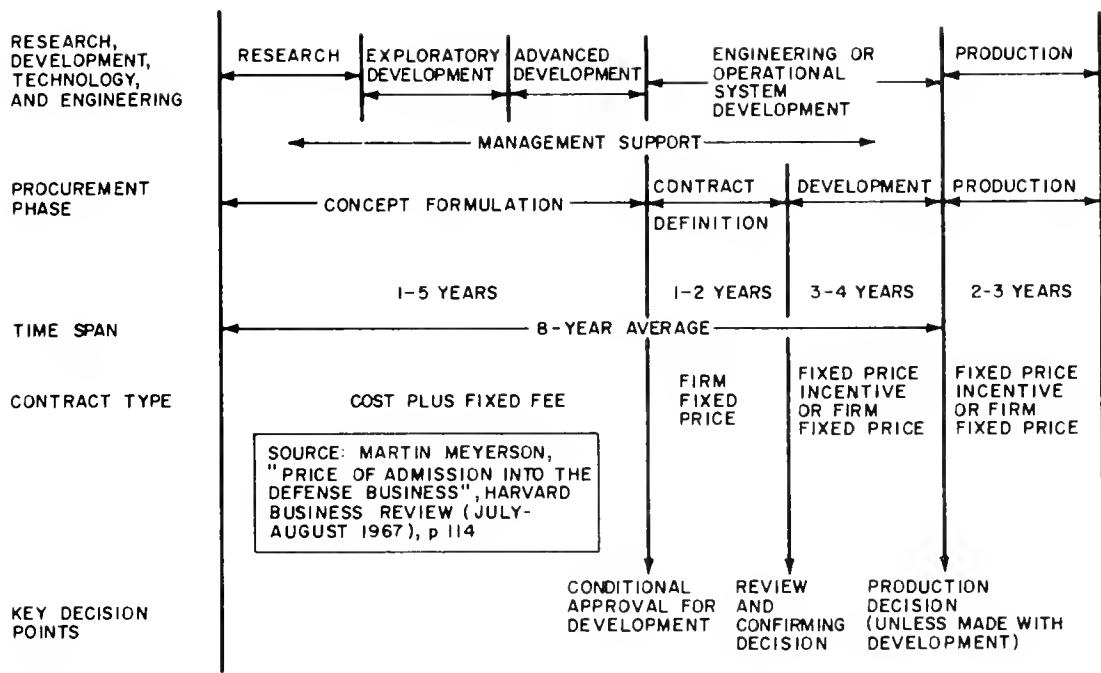
- SOURCES: a. "Defense Department Lists Top 100 Contractors for Fiscal 1965," Aviation Week & Space Technology (December 20, 1965), 75.
- b. "Defense Department Lists Top 100 Contractors for Fiscal 1966," Aviation Week & Space Technology (December 12, 1966), 104.
- c. "Top 100 U. S. Defense Department Contractors for Fiscal 1967," Aviation Week & Space Technology (January 1, 1968), 72.

CONCEPT FORMULATION

The concept formulation phase, as described by DoD Directive 3200.6, dated June 7, 1962, is divided into the categories of research, exploratory development, and advanced development. As shown in Figure 2, this period is generally one to five years for weapon systems. It is the period which encompasses the activities preceding a decision to carry out engineering development. Early in this phase, the contractor's effort may consist of applied research and development of technology applicable to, or closely associated with, a particular product system or product area. Contractors probably expend a slightly more amount of contractual than non-contractual effort during this phase.

In the latter portion of the concept formulation phase, contractors generally emphasize system conceptual studies to meet an existing or conjectured mission even while continuing applicable research and development effort. Non-contractual effort generally exceeds the contractual effort, particularly in preparing for a major proposal associated with contract definition or design. Programs may be initiated anywhere in the concept formulation stage, but they must progress through contract definition prior to full-scale development unless specifically waived in writing by DDR&E.

It is during this phase that the best technical approaches are selected by thorough trade-off analyses, and the cost effectiveness of the proposed system is determined to be favorable in comparison with other competing systems. Furthermore, the estimates of costs must be credible and acceptable, and the mission and performance envelopes must be defined. Much of the experimental



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FIGURE 2

R & D CYCLE

effort is required to be accomplished during this phase, leading to the technologies needed to develop the system.

Toward the end of the concept formulation phase, contractors are primarily engaged in preliminary design efforts to identify a system configuration that might meet the requirements of the work statement. Although work statements were not formally issued prior to request for the CDP, it was learned from the interviews that work statements existed in essentially the same form, without any significant changes, as many as four years prior to the request for proposals for a competitive CDP. Except for the contractual incentives and name of the program, work statements were essentially unchanged for a long period of time. The performance criteria, mission envelopes, and required trade-off studies were known well in advance of the RFP.

It appears that most of the concept formulation time is not for conducting numerous analytical and design trade-offs to permit the configuration of a weapon system, but rather for receiving the appropriate funding and approvals at senior procurement levels. Lack of any particular system-oriented funds during the concept formulation phase prevents the formal issuance of work statements. A complete system development work statement is prepared during Phase B of the contract definition phase.

The peak contract technical manpower involved during the conceptual phase is approximately one-tenth the peak required during the CDP (see Figure 3). The horizontal scale in Figure 3 is translated to superimpose peak manpower.

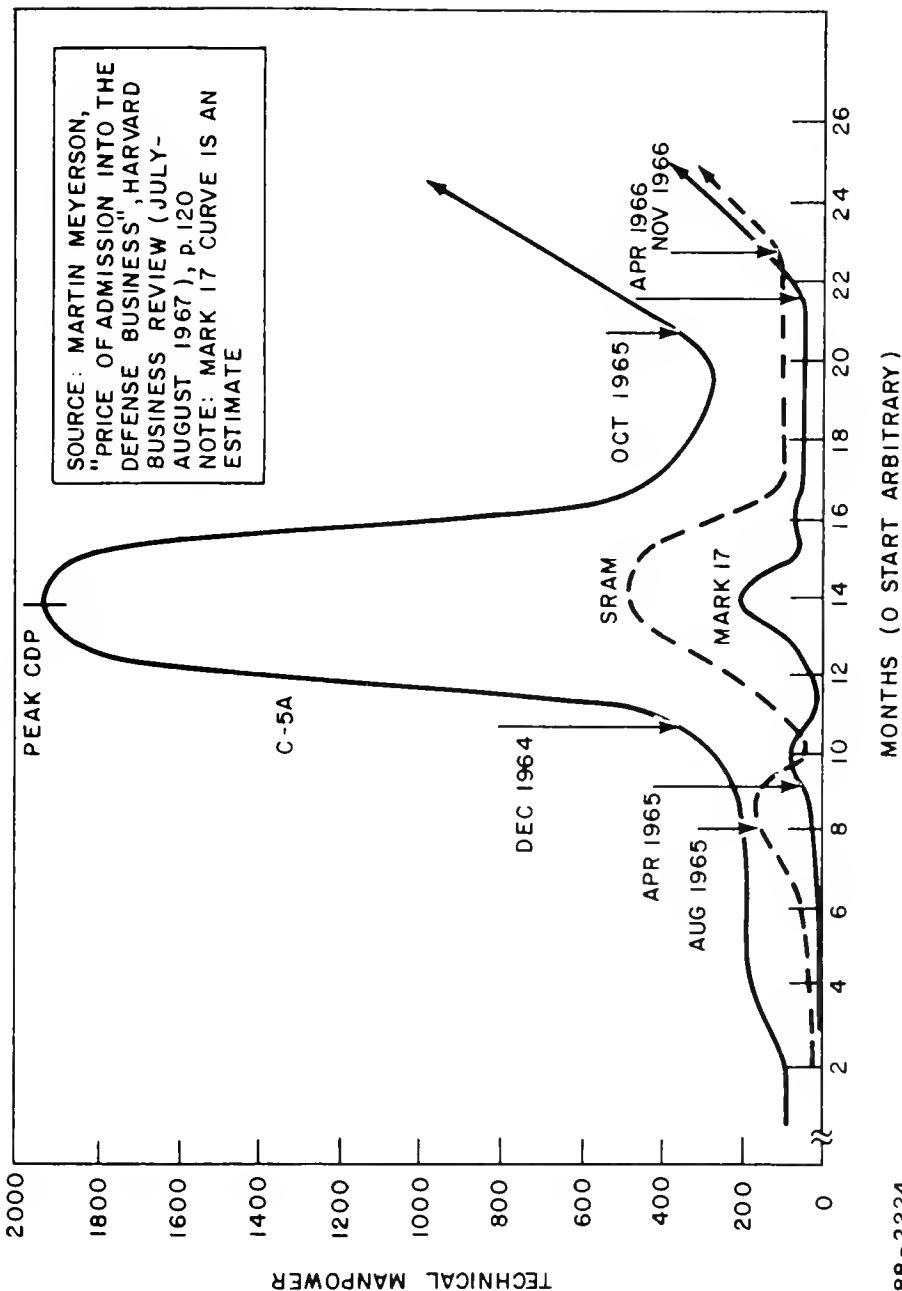


FIGURE 3
PEAKS IN CONTRACTOR
CONTRACT DEFINITION ENGINEERING MANPOWER

Calendar dates shown are start and end of CDP. Pre-CDP technical manpower is engaged primarily in company-funded, system-oriented studies. During this period, contractors maintain continuous liaison with the Air Force System Program Officer (SPO) to 1) determine if any changes in the work statement are contemplated, and 2) determine when the program will be approved for CDP. This communication is essential both to the contractors and the government. For the contractors, it provides updated information on the system requirements so that the contractor effort can be better directed toward a more adequate CDP response. Furthermore, it provides a contractor with an indication of the amount of government funding available for the CDP, so that he can plan his resources to effectively respond to the CDP. The government benefits in that task descriptions of the work statement can be clarified and schedules can be validated. Furthermore, the government gets an indication of the competitive interest in the program.

From the time an initial work statement is generated containing the mission and performance requirements, to the time a work statement is issued for competition in the CDP, very little effort is performed to further define the total program. Effort is directed primarily to determining whether or not the system is economically sound and within the budget of the responsible service. Since CDPs are of relatively short duration compared to the total R&D cycle (compressed by a development program with tight Initial Operational Capability (IOC) dates, and overlapping production), considerable government and industry efficiencies can be achieved by moving more system definition into the concept

formulation phase. Concept formulation takes about twice as long as contract definition, and requires more company funds than government funds; furthermore, it uses, on the average, significantly less people than contract definition. By shifting total resources to this phase, both the government and contractors can alleviate CD funding and manpower peaks and can better accumulate the information needed to proceed with the program. The government will have better cost effectiveness information, and the contractor will reduce the high risk presently associated with winning a TPPC contract on an undefined system.

CONTRACT DEFINITION

Under the total package concept, the contract definition period beginning with Phase A (see Figure 1, Chapter III) represents not only the Secretary of Defense's conditional approval for entering into a contract definition and development phase, but also conditional approval for as much of the production and operational support as can be identified in the RFP. The contract definition phase establishes firm schedules and cost estimates for development and production, and provides a fully incentivised contract.

Schedule

Phase A of contract definition is the period in which contractors will be selected to enter into Phase B--the contractor CD effort.

The primary purpose of Phase A is to select two or more contract definition contractors, who will enter into a program definition by competing, under government funding, for the acquisition, development, and production

of the system. As already mentioned, the two or three prime contenders for contract definition are generally quite evident to both government and industry even prior to the initiation of an RFP for Phase A. In the case of the C-5A, Phase A was waived, since the government determined that only three prime airframe contractors and two engine contractors had the capability to develop and produce the weapon system. For Mark 17 and SRAM, Phase A resulted in only three contractors submitting proposals for Phase B, with one of the Mark 17 bidders withdrawing his proposal soon after submittal. The DoD directive on contract definition implies that CD should last no longer than six months, with three or four months the norm. An examination of the contract definition schedule in Figure 4 shows that the total contract definition phase lasts very close to one year from the initiation of RFPs for Phase A contract definition. Appropriate directives indicate that decision action (Phase C) should take place within eighteen weeks--yet we see six to eight months for Phase C.

With the exception of the C-5A, acclaimed to be a straightforward job of engineering development, government interviewees indicated that the time required for Phase B contract definition was not adequate to define the system per DoD Directive 3200.9, and that the programs were subjected to too many external influences combined with high risk interfaces and performance requirements. Contractors generally agreed, indicating that the time may have been sufficient provided they were convinced that the system was a straightforward job of engineering development, with the building blocks capable of being generated during the CDP.

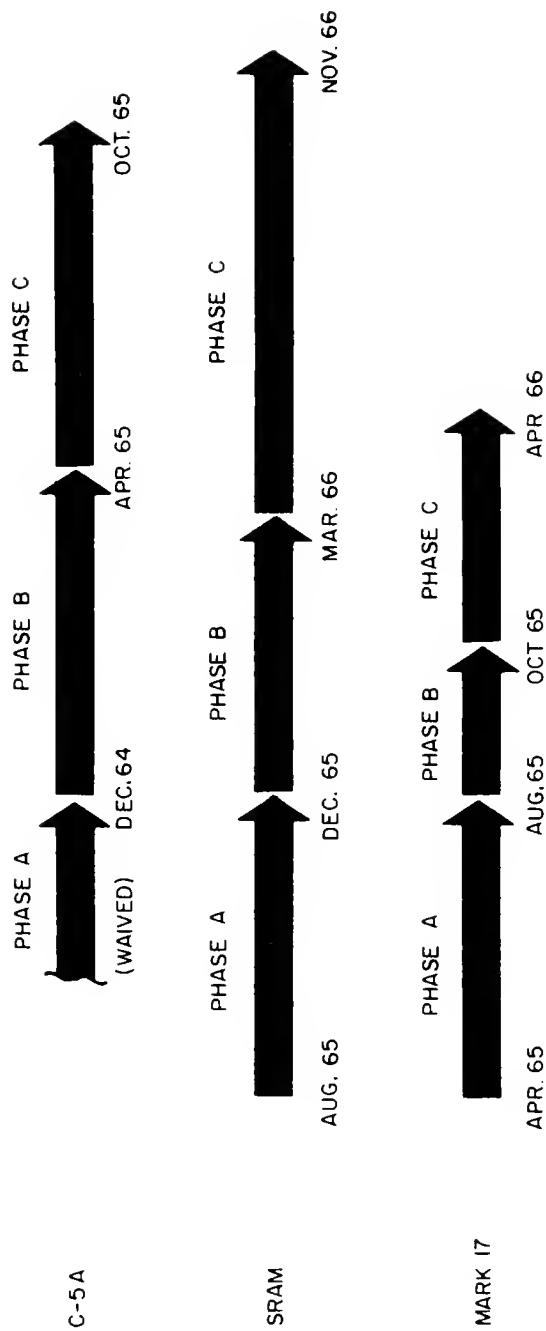


FIGURE 4
CONTRACT DEFINITION SCHEDULE

Cost

Although firms participating in the programs studied were hesitant in providing their costs for contract definition, several sources provide an insight as to what these costs might be. A summary of these costs, including definition costs as a per cent of contract price, is given in Table IV. An interesting consistency about contract definition costs is that the government funded approximately one-third of the prime contractor program definition costs. Furthermore, the contractors' cost for program definition is between 1 and 2 per cent of the total program target price, including options. As a percentage of the initial program price, the contractor definition costs were slightly higher. The SRAM figures are somewhat distorted in that the initial contract did not include a firm government commitment for production, whereas the other contracts did. SRAM definition cost as a per cent of initial cost is high because the initial contract was for development only. All production was on option.

Although no comparative data are available, there was a consensus that total package CDP costs were greater than previous programs. Contractors, in fact, indicated that they were. Contractor interviewees pointed out that company funding was required to be minimally responsive to the RFP. They indicated, however, that their firms would continue to contribute to program definition in future programs, but that they could not afford to be second very often. (One of the C-5A interviewees claimed that the firm spent \$36 million, including government funding.)

TABLE IV
**PRIME CONTRACTOR
PROGRAM DEFINITION COSTS**
(In Millions of Dollars)

Contract	Contractor	Concept Formulation and Contract Definition (including Phase C)			Program Target Price			Definition Costs as per cent of . . .	
		Contractor Costs	Government Costs	Total Costs	Initial Production Options	Total Including Production Options	Initial Target Price	Total Target Price	
C-5A	Boeing	20	16	8	24			1.7	1.1
	Lockheed	16	15	6	24			1.7	1.1
	Douglas	20	12	8	20			1.4	0.9
	Total	56 ^a	43 ^b	44 ^c	24 ^c	68 ^c	1,400 ^f	2,200 ^f	3.1
SRAM	Martin	5.7 ^d		2.75	8.5			5.9	1.6
	Boeing	9.2 ^e		2.75	12.0 ^e			8.9	2.3
	Total	12.0 ^c		5.5 ^c	20.5	144 ^{f,g}	521 ^f	13.8	3.9
Mark 17	Avco	0.700 ^e		0.325 ^e	1.0			1.3	0.9
	GE	0.600 ^e		0.325 ^e	1.0			1.3	0.9
	Total	1.3		0.65	2.0	75 ^f	107 ^f	2.6	1.9

SOURCES: a) John Mecklin, "The Ordeal of the Plane Makers," *Fortune* (December, 1965), 280.

b) "Pentagon Tests One-Stop Bidding," *Business Week* (November 6, 1965), 99.

c) Total Package Procurement Concept: Synthesis of Findings, (Logistics Management Institute, June 1967), pp. 19, 21.

d) Martin Meyerson, "Price of Admission Into The Defense Business," Harvard Business Review (July-August 1967), 119.

e) Estimate.

f) Actual contract.

g) Development price only.

Even though the DoD directive requires full funding of contract definition efforts, many of the government officials feel that they will not fully fund as long as contractors have an appetite to contribute to contract definition. On the other hand, the government is under the impression that they are paying for all the CD information. The Defense Department has been concerned, because it realizes that government needs the prerogative of using the data received from contract definition as it sees fit. A study on contract definition funding, initiated by the Defense Department, resulted in a Defense Procurement Circular dated January 31, 1968, which reiterates that contractors should be approximately equally funded. More important, however, it stresses the full-funding aspects of contract definition. This circular appears to be merely a face-saving memo to ease the present controversy regarding the fully funded aspects of the CDP.

Other studies have attempted to determine the definition cost of a program as a per cent of the program total costs. One study indicates that in the aggregate, for development-only contracts, the prime contractor cost is approximately 7.1 per cent.⁵ Another study on the C-5A indicates that the cost of contract definition amounts to 6.5 per cent of the total program price of \$2.6 billion, which includes the efforts of airframe contractors, engine contractors, the major and minor subcontractors, as well as the government contribution.⁶ This same study indicates that for four total package contracts, including the Navy's Fast Deployment Logistic Ship, the

⁵Martin Meyerson, "Price of Admission into the Defense Business," Harvard Business Review (July-August 1967), 119.

⁶Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June 1967, p. 20.

definition cost as a per cent of initial contract ranged from 4 to 11 per cent, and that the definition cost as a per cent of total program cost hovered between 3 and 6 per cent. The data presented in this study generally confirm the above results. The Mark 17 definition cost as a per cent of total program price (2 per cent) was somewhat lower than the LMI study.

It is expected that the actual cost of defining the program under the total package concept is significantly greater than what is represented by these figures, for several reasons. First, none of the figures include the vast amount of government effort required to evaluate the contractors' proposals. Second, the contractors are hesitant to provide the actual figures, since they know that much of the costs are reflected in several overhead charges, thus broadening their overhead base. Third, as one contractor explained it, underfunded CDPs encourage the contractor's technical people to cheat, by having in-house cost reimbursement government-funded programs wind up sharing a burden of the definition cost indirectly.

In summary, as long as competitors are willing to contribute company funds to the definition of a system, the government does not intend to fully fund. The RFP work statement requires that the contractors contribute to the definition of a program to be minimally responsive. Neither funding nor time is adequate to develop the necessary detail and accuracy required in establishing the technical building blocks to proceed with a straightforward program of engineering development. The contract change activity on both the SRAM and Mark 17 contracts provides adequate evidence that this

definition was not accomplished during the contract definition phase. Since contractors are willing to compete in an atmosphere of underfunding and schedule pressures, the resulting efficiencies will accrue to the government at the expense of the losing contractors.

Manpower

The application of contract definition to the total package concept raises several issues regarding manpower level, amount of required data, and the response time of the government, compared to other programs. All interviewees concurred that the manpower input for total package contract definition was much greater than on previous comparable programs. Both government and contractor interviewees expressed a grave concern for the fact that during Phase C contractors diverted vast resources from other programs to be responsive within the time limits established by the RFP and DoD--only to face considerable delay between the recommendation of the selection evaluation board and the award decision by the source selection committee.

One study indicated that the peak engineering manpower level during contract definition was one-half that required to conduct the development program.⁷ The LMI study states that the contract definition has accomplished an aggregate saving in national talent, even though firms competing for a particular program, and their SPO counterparts, are faced with increased manpower needs.

⁷Meyerson, op. cit., p. 120.

Contractors indicated that a great portion of CD effort was required to define the production, support, and logistic requirements to be able to make a firm commitment on cost. This disagrees with the opinion of Secretary Charles, who claims that competitors can make binding commitments on production with relatively small additional effort.⁸ In fact, on the C-5A program there is still uncertainty as to what the contractor's commitment is relative to the supply of spare parts and ground support equipment, particularly in service to the engines.

As can be seen from Figure 3, the phasing of contract definition peak manpower is similar for each of the programs studied. Enormous manpower build-up rates are required in the few months preceding the peak. The CDP is therefore an extremely short period of time for a comprehensive program risk determination, requiring sharp manpower peaks to respond timely to the government RFP. Although the peaks in engineering manpower represent an average of the competitors, the C-5A, for example, required well over 5,000 engineers to complete the contract definition phase. These peaks in engineering manpower represent an order-of-magnitude increase over the concept formulation stage, and are necessary to be responsive to the RFP in the one and only available chance. This rapid manpower buildup could be avoided by a more gradual increase, starting in the concept formulation phase.

⁸Robert H. Charles, Total Package Procurement Concept (February 18, 1966), p. 8.

Proposal Activity

Fourteen copies of the RFP, containing 1,287 pages of requirements, were distributed to each C-5A competitor. During contract definition Phase B, contractors presented 1,783 inquiries to the SPO. The SPO responded with 1,600 pages of clarification and revisions, including 294 specific changes to the RFP.⁹

The C-5A competitors responded at the end of Phase B with 35 tons of paper, since each was required to submit 40 copies of his proposal. The Air Force source evaluation board (SEB) was left with the task of evaluating 240,000 pages of proposals submitted by the five competitors. Douglas alone accounted for 625 volumes. The Lockheed bid was 30 feet thick. All contractors met their delivery deadlines, mostly by delivering their proposals in special planes.

Repeatedly, the SPO went back to the competitors during Phase C for better documentation of their proposals and to ascertain the feasibility of additional changes and their impact on cost. During this period, the Air Force peppered the C-5A competitors with some 600 "suggestions" on ways to correct deficiencies in their proposals, asking them in each case to consider whether their corrections were feasible and to estimate any additional cost. As one SPO officer indicated, the answer would generally be one thousand pages bound in hard covers and usually in color (and this only applied to minor points).¹⁰

⁹John Mecklin, "Ordeal of the Plane Makers," Fortune (December 1965), 28.

¹⁰Ibid., p. 160.

During Phase C of the SRAM CD, competitors received 1,246 change notices requiring 37,000 page changes to their proposals. These changes resulted in an increase in the initially proposed target cost of over 40 per cent. One month after submittal of the CD proposals on the Mark 17 contract, competitors were required to resubmit their proposals based on a design performance change in the program.

Contractor effort was not all Air Force initiated. Lockheed, in assembling the largest team ever for an aircraft design effort, also prepared a brochure on the plane management group, complete with organization charts, pictures, duties, and resumes. From time to time it issued progress reports on its design efforts, and had its engineers out in force before professional societies describing potential technical approaches for the giant plane.¹¹

Data Submittals

There is overwhelming agreement, not only among the interviewees, but also throughout the literature, that the amount of data requested was much more than required on previous programs. Technical planning documents and technical proposals made up one-third of the data submitted by the C-5A contractors. These data were essential, in that they described how the task could be done and how detail design problems would be resolved. They were used by the selection evaluation board to determine whether

¹¹"C-5A: Lockheed's Path to the Future," Business Week (October 9, 1965), 33.

the content of specifications prepared by each contractor was realistic and complete, and whether the approach was likely to proceed within the required time limit and result in the most effective system. Much of the data were essential to a meaningful technical evaluation; however, in the case of the C-5A and other programs, the total data submission was far too voluminous and detailed. Although considerable improvements were made subsequent to the C-5A award, resulting in proportionally less data for the SRAM and Mark 17 programs, it was agreed by the Air Force and contractors that much more data were required than needed for an award decision. It was felt that much of the data could be deferred to Phase C or later.

There was no effort to restrict the proposal size for the contracts studied although this would have tended to eliminate "brochuremanship". Such a restriction would require considerably more effort on the part of the contractor to boil down his proposal to the essentials; however, it is expected that this effort would be worthwhile if it accelerated the source selection. Since the evaluation board is able to evaluate the proposals on time, it appears that a streamlined proposal would save SPO CD effort but not accelerate the award decision. The bureaucratic delays of the selection committee will continue and are independent of the CD proposal evaluation.

Additional CD manpower leveling could be realized by having data required to define the model contract provided later during Phase C. Many items of the cost and management proposals are not required and are not in concert with the total package concept. Many of the requirements in this

portion of the proposal are of common knowledge to the SPO, and such information as the contractors' quality control procedures, management configuration board procedures, and other standard management practices are constantly reviewed by local Air Force Plant Representatives to validate the firm as a defense contractor. Many SPOs and civilians have more knowledge of the contractors' management practices than some of the individuals preparing the proposal.

Make-or-buy decisions for production hardware were not even looked at on two of the contracts. However, one SPO indicated that the Air Force was interested in the type of activities the prime contractor was engaging in and whether the firms were building up a capability which already existed in other firms. This attitude seems to be inconsistent--not only with the total package concept, but with the basic premise of free enterprise competition, and more important, a binding fixed price. Therefore, it does not appear to be valid. Since each contract required the use of existing facilities, proposal requirements for facilities usage to the extent required on non-TPPC contracts also appears to be a non-critical item. In general, many of the "boilerplate" items required by the RFP are available in Air Force data banks and only serve to encumber the contractors' proposals.

Cost Data

Cost and pricing data requested by the Air Force and submitted by the contractors were far in excess of the actual requirements. It was concluded that in a competitive procurement such as the C-5A, the detailed breakout

of individual line items, which represents a relatively insignificant portion of the total system price, is not required. On the C-5A, an attempt was made to identify and price the aerospace ground equipment (AGE) and individual spare parts over \$500. Their combined costs probably represent about 50 per cent of the total system cost. Many of the 2,000 spare parts in AGE were poorly defined, leaving it very questionable as to what the established price truly represented.¹²

One source of trouble in data submission is the imposition of the Air Force Systems Command (AFSC) 375-1 through -5 manuals. Although the Systems Engineering Management Procedures (375-5) are conceptually compatible with the TPPC, they are of greater value when used on less defined systems. Across-the-board application on the TPPC contracts is much too detailed and inconsistent with contractor assumption of increased risk.

Detailed submissions of AGE and spares were not practical. By satisfying the government need for a work breakdown structure in accordance with the manuals, cost data were not summarized at the highest practical level. While senior-level procurement personnel indicate that the AFSC manuals must be used as a guide rather than a rigorous contract requirement, the manuals are placed on the contract at the outset with the implication of being a firm contractor requirement. The total package concept espouses relaxation of controls and disengagement of government interference with the day-to-day activities of the contractor, yet the manuals

¹²Major General Gerald F. Keeling, "Total Procurement Package," Aviation Week & Space Technology (April 25, 1966), 21.

impose a requirement for approval of detailed contractor design decisions from preliminary design through the critical design reviews.

Not only must the detailed contract end items be priced in accordance with a work breakdown structure, but these items must further be priced in accordance with fiscal year expenditure. There appear to be too many variables to make itemized fiscal-year costing real, and neither of these exercises lies at the core of the selection evaluation board, particularly in the total package environment. Furthermore, to satisfy Congressional appropriations requiring separate funds for research and development and production, proposals require additional breakouts of spending not only by fiscal year and item, but also by development or production cost. While the contractor has complete authority to mingle production funds and R&D funds, the Air Force directives and ASPR regulations preclude funding in other than two separate pools. Furthermore, DoD Directive 7400.2 does not provide for incremental progress funding, but provides funds for production by fiscal year only. Multiple-year procurement processes, however, have been instituted to circumvent this directive.

Air Force procurement officers, appreciating that this type of information is of no significant use to them or the contractor, claim that the regulations are vague and that there is no special documentation to provide TPPC guidance. The only alternative is to work to the letter of existing documentation and try to tailor the regulations even though the contractor commits to a single fixed price.

Another requirement affecting total package contracts is the Air Force Systems Command (AFSC) Manual 310-1, dealing with data management. This manual requires contractors to supply itemized costs for each contractor-prepared data requirement.

The Air Force recognizes most of these problems, and is attempting to reconstruct many of their requirements so that they can be used selectively under high risk cost reimbursement contracts or for visibility under fixed price contracts. Recent indications, however, are that the revamping of procedural requirements are leading to a proliferation rather than consolidation and reduction of Air Force required data. While new "consolidated" requirements appear, many of the old ones still remain, compounded by additional data (i.e., AFSCM 310 will require not only the price of a whole document but a breakdown of the costs of printing, reproduction, etc.).

Secretary Charles questions whether 7,000 pages of cost data (as were submitted on the C-5A) were really required.¹³ Under the TPPC it is of more concern to the contractor than the government, which has a firm commitment under price competition with a model contract identifying an incentive fixed price including a ceiling beyond which all costs are borne by the contractor. Charles' question is generally answered by the LMI study, which indicated that one contractor required 32 times as much financial data as on other recent programs.¹⁴ Another firm interviewed by LMI indicated

¹³Robert H. Charles, Total Package Procurement Concept (February 18, 1966), p. 7.

¹⁴Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June 1967, p. 28.

that 60 per cent of its entire technical effort involved defining the support aspects of the program--that is, defining support in sufficient detail to price.¹⁵

In summary, more data are required for the total package procurement concept than other concepts because:

1. the program commitments include production and support requirements as well as development;
2. the Air Force manuals and regulations instituted for the sequential-type contracts compound the amount of effort required when added to the production and support;
3. separate R&D and production funding regulations are still being applied to TPPC contracts; and
4. consolidation of data requirements is not conceived within the fixed price, TPPC, increased contractor risk procurement environment.

Unable to unravel and modify the existing manuals and regulations to become compatible with the TPPC, the Air Force has attempted to limit the cost proposal on the Maverick program to a maximum of 25 pages, thus leaving the contractor to exercise selective negligence of contractual manuals and regulations.

Model Contract

One of the most beneficial results of the Phase C negotiations by the selection evaluation board is a model contract which both parties are

¹⁵Ibid.

willing to sign and live with after the source selection is made. This negotiation is with all CD contractors in a competitive atmosphere. During Phase C, contractors are requested to perform additional work which is beyond the scope of their CD contracts and for which they can request reimbursement. However, as most contractors pointed out, it was very difficult to ask for reimbursement for this effort beyond the funding of key personnel.

The SRAM SPO, knowing that whatever funding available for change activity was much too small to be meaningful, did not fund any effort from the time of receipt of the contractors' CD proposals to the award decision. However, contractors were informed during the latter part of Phase C that the contract award would be back-dated several weeks to pick up whatever effort the contractor might have expended to meet the proposed schedules. The contractor reaction to this lack of adequate funding for responding to evaluation committee inquiries, was that once they had expended the firm's Phase B CD funds they would do practically anything asked--including the signing of a contract under whatever conditions the Air Force might require.

The Air Force argues that not only does the negotiation period provide a common base for source selection, but a major part of program definition is taking place during Phase C. Their position is that they will not get a really acceptable proposal and set of specifications from anybody (much less from at least two contractors) until they have seen and had a chance to react to what is offered as often and as intimately as necessary during Phase C.

They argue that only details of contract negotiations provide the true test of what contractors are willing to provide for a given price.

This approach is in conflict with DoD Directive 3200.9 which states that "Source Selection for engineering development shall be based upon proposals as initially submitted in order to stimulate the best possible proposal." This statement implies that to stimulate the highest level of competition, the government should react to the proposal as submitted by the contractors without attempting to institute any technical transfusion or any further price competition. One of the most significant outcomes of Phase C, however, was price competition--in which it appears that the government maintained an upper hand.

Collaboration

One Air Force argument indicated that contractor proposals are never completely responsive to the RFP because of omissions and exceptions to terms and conditions. Therefore, not only is cleanup work required during Phase C, but more significant work is also required. The tactics involved in defining the model contract during Phase C are not only to establish a common base of technical performance and cost, but also to instill some technical transfusion between the design approaches of the contractors. This attitude has opened the door to numerous instances during Phases B and C of contract definition which can be considered in the realm of close collaboration, as defined by DoD Directive 3200.9 ("Contract definition

will generally be conducted as a DoD financed effort by two or more contractors working in close collaboration with DoD components having development responsibility").

The concept of collaboration is generally misunderstood, not uniformly applied, controversial, and based on questionable assumptions. On the one hand it defies the traditional doctrine of non-involvement of government personnel with individual suppliers after RFPs have been issued or competitive contracts have been let, to gain the benefits of competition. On the other hand, close collaboration provides the following benefits:

1. It helps ensure that the final source selection is made on the basis of more than simple paper inputs.
2. It permits the elimination of false starts in the various areas.
3. It more than makes up for the extra time it requires by careful pre-scrutiny of a contractor's plans and approaches.
4. It ensures that contractors will be fully responsive to the RFP requirements.
5. It determines whether the contractors are taking approaches to their proposed designs that exceed the threshold of risk which the government is willing to take on the program.
6. It permits the government to better define what it wants.

DoD Directive 3200.9 indicates that the "Director of Defense Research and Engineering (DDR&E) will provide more detailed guidance in the form

of a DoD guide for Contract Definition."¹⁶ Although not official, DDR&E sponsored a report on government guidance for contract definition.¹⁶ This study (here referred to as the PML study) reportedly covers the thinking of many people in the Department of Defense, and largely stresses the provisions of what it calls the practice of negative guidance. The PML study states:

In this practice, contractors are informed that a proposed approach has proven infeasible in the past or is questionable or that some areas of their effort will need additional substantiation. The contractors are not informed, however, of what approaches the sponsoring component feels would be acceptable or of the approaches being pursued by any of the competing contractors. In this manner, negative guidance does not discourage originality or the consideration of alternates; nor does it give any contractor a competitive advantage. The practice of providing negative guidance, therefore has proved to be an important contributor to successful close collaboration.¹⁷

Another Air-Force-sponsored report, from MITRE Corporation, attacks the PML study on the grounds that it does not provide detailed information on what constitutes proper negative guidance.¹⁸ The MITRE report suggests ways for in-house people to proceed on the more substantive aspects of accomplishing close collaboration during contract definition. The report also suggests certain administrative and procedural arrangements for the accomplishment of positive guidance on the collaboration issue.¹⁹

¹⁶ A Report on Contract Definition (prepared for the Office of the Director of Defense Research and Engineering by Peat, Marwick, Livingston and Company, January 2, 1967).

¹⁷ Ibid., p. 55.

¹⁸ Norman Waks, Close Collaboration in Contract Definition (prepared by MITRE Corp., February, 1967), p. 18.

¹⁹ Ibid., pp. 50-53 and Appendix C.

Government reaction to collaboration during the contract definition phase indicated that the Systems Engineering and Technical Direction (SETD) did not fully understand what it wanted, nor was it able to define the interfaces and performances to the degree necessary to avoid further discussions during the CDP. This was particularly evident in the SRAM and Mark 17 programs, where several changes in the RFP subsequent to its release resulted in numerous interface, performance and specification requirements changes. The C-5A experience also indicated the need for the government to assume a stronger role during contract definition.²⁰ This collaboration was required in the opinion of the contractors and the government, not so much to transfuse items of technology, but more to establish firmly the requirements of the system so that contractors could define their own design approaches to meeting these requirements. One government official indicated that they were not looking for transfusions as much as they were trying to tie down the requirements and the interfaces of the weapon system.

Technical Transfusion

Indications are that if any technical transfusion is desired by the government, it must be accomplished prior to the receipt of CD proposals. Several contractors indicated that although the government did not attempt to make explicit design approach recommendations, the performance criteria were changed or slanted such that a particular design approach would have to be used. The response of contractors to this tactic

²⁰ Lessons Learned from Contract Definition (prepared for ODDR&E by Peat, Marwick, Livingston and Company, August 16, 1965), p. 8.

indicates that such a procedure is out of character with the total package concept, and destroys the advantages purportedly to be gained through independent competition. None of the programs studied indicated any significant level of technical transfusion during Phases B or C of contract definition. The LMI report points out that any transfusion manifests itself in the RFP released for the CDP.²¹ The lack of technical transfusion is evident in the case of the C-5A. One contractor had a particularly appealing design for the forward loading, but it was not practical to incorporate it into the other two contractors' designs.²²

Source Selection

The winner of a major defense contract is chosen through a source selection process established by DoD Directive 4105.62. Under this directive, OSD appoints a source selection authority, sets up a source selection council to establish evaluation factors and weighting values, and establishes a departmental selection evaluation board (SEB) to quantitatively and qualitatively evaluate CD Phase B proposals from approved and designated contractors. Evaluation factors are published in the RFP distributed to the bidders. Contractors presenting the best costs, schedules, and technical proposals, as evaluated by the SEB using criteria established, published, and weighted by the source selection council, will be picked by the source selection authority to proceed with Phase II of development. On

²¹Total Package Procurement Concept. Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June 1967, p. 71.

²²Keeling, op. cit., p. 21.

major programs, selection must have the approval of the OSD Secretary as well as the blessings of the President.

Offerers are reminded in the RFP that the government will place emphasis on the technical and management portions for the CDP, and that participants in the CDP will have their proposals evaluated by a source selection committee, with considerable emphasis placed on cost (see Appendix D). On the SRAM program, contractors responded to a multiplicity of changes to their CDP proposals during the selection evaluation board proceedings by a 40 per cent increase in target cost over the initial proposals. As already cited, this was for development costs only, since production was on options. On the other hand, the Mark 17 CD contractors, responding to multiple changes, negotiated in a price competition atmosphere. The target costs submitted in one Mark 17 CDP proposal were reduced by close to 12 per cent of the initial proposed target cost. The contract was awarded to an offerer whose target price was 1 per cent greater than its competitor. Presumably, the award decision was made on a superior technical and management proposal.

Technical excellence, however, is not the sole criterion for making an award. An Air Force evaluation team of 500 officers and civilian technicians, headed by four generals, spent two and one-half months and a total of 132,000 manhours reading and evaluating the C-5A proposals.²³ The SPO staff, in

²³Lt. Gen. W. A. Davis, "Management Systems for Package Procurement," Defense Industry Bulletin (December, 1966), p. 2.

preparing for Phase C evaluation, conducted exhaustive independent studies, including the preparation of a 2,000 page cost analysis report for comparison of the competitors. On the C-5A, the Air Force selection evaluation board, after completing two and one-half months of study, recommended to the source selection committee at DoD that The Boeing Company should be awarded the contract to build the C-5A. The selection evaluation board on the C-5A program argued that The Boeing Company proposal promised much better performance than either of the other competitors. The evaluation board praised the Boeing aircraft's higher speed and better lift characteristics, and suggested that Lockheed's proposal might not even be able to meet the minimum requirements for short takeoff and landing. They argued that the Boeing plane was worth the additional cost.

In Washington, the source selection committee overruled the evaluation board and opted for Lockheed, whose ceiling price was almost \$300 million less than Boeing's.²⁴ The Air Force then asked all bidders to "improve" their proposals. Boeing and Douglas reduced their bids; however, Lockheed's ceiling price was still the lowest by \$292 million. The Secretary of Defense, in announcing the Lockheed award, stated that the combination of performance and price promised by the Lockheed proposal was superior to that of the other bidders.

One writer indicates that the decision reversal had the effect of preventing the impact of a major contract from endangering the overall health

²⁴Mecklin, op. cit., p. 283.

of the aircraft industry.²⁵ The argument was based on the fact that Boeing had almost \$3.7 billion of backlog, primarily in commercial aircraft. Douglas had a \$1.07 billion backlog, and was also one of the main contractors for the Air Force's \$1.5 billion manned orbiting laboratory. Lockheed, however, had a \$1.7 billion backlog, mostly in the C-141 jet transport, soon to be phased out.

It should not be assumed from the above that the award was made solely on the basis of price or on geo-political considerations. For the first time, a selection board considered not only the technical merits of the airframe and engine, but also cost effectiveness. This was based on a \$2 billion equation:²⁶

$$\text{Cost Effectiveness} = \frac{(UE) \times U \times V_b \times P \times C_p}{\text{Cost}}$$

In this formula, UE represents unit equipage (number of planes for six squadrons); U is the utilization rate (hours in the air per day); V_b is block speed (the time between two given points at most efficient crusing speed plus fifteen minutes); P is payload; C_p is correction of payload for terminal effectiveness (meaning minimum landing runway length required), and determines how many airstrips the plane can use in remote areas like Southeast Asia. Cost is the price of six squadrons plus ten years of operating expenses.

²⁵Ibid., p. 158.

²⁶Ibid., p. 284.

The implications of the C-5A contract were so far-reaching, however, that the impersonal computer calculations could not be given the last word; in the end, human judgment and controversy came into play.

A review of the source selection techniques and procedures used on the C-5A led the Air Force Systems Command to the conclusion that there are opportunities for greatly reducing the effort without any detrimental effect on the quality of the selection or on equitable treatment of the competitors.²⁷ Simplification could be achieved by sharply curtailing the evaluation criteria to the really significant and critical considerations that lie at the core of decisions, and by eliminating the peripheral issues that may be interesting but not important in controlling the decision. As one senior Air Force procurement officer put it, "We didn't establish our cost effectiveness criteria early enough--particularly as it relates to 10-year maintenance and reliability cost effectiveness."²⁸ Considerable time and effort is spent by the source selection committee on items which merely require validation or verification to ensure that what the contractor proposes to provide is satisfactory. Most of this effort can be saved by including items which require evaluation and are point scoring and subject to meaningful analysis.

While both contractor and government interviewees indicated that proposal evaluation was within the service agency's manpower capability, it was generally conceded that the overall life cycle cost effectiveness on the system was well beyond their capacity because of a lack of defined criteria.

²⁷Keeling, op. cit., p. 21.

²⁸Col. Robert E. Lee, "Total Package Procurement Concept," Defense Industry Bulletin (August, 1966), p. 12.

DEVELOPMENT PROGRAM IMPLEMENTATION

The development of a new weapon system in the current environment of technological and management revolution coupled with tight budgets and tighter profit constraints is a major challenge to government and industry. The challenge is compounded by the demands of Congress and DoD procurement officers to increase the efficiency of developing and producing the systems. Total package procurements give early visibility to evolving programs and provide significant information regarding the cost to the government of development, production, operation, and support.

For industry, however, less information is available regarding the nature and cost of building weapon systems. This ignorance on the part of the contractor results from a long-term firm price commitment prior to the initiation of development. Admittedly, the contractor has a better feel for what the ultimate costs of the weapon system might be, but the uncertainty of these costs is bounded by a commitment to a ceiling price beyond which the contractor absorbs all costs. This provides built-in cost protection to the government and risk to the contractor.

Along with the assumption of greater risk by the contractor must go the possibility of higher profits. To realize higher profits in a high-risk atmosphere, the contractor must 1) institute tougher management control; 2) be able to look forward to fewer government administrative and auditing controls; 3) exercise increased decision-making responsibility; and 4) negotiate a contract

with adequate profit features. This requires that contractors become completely and expensively involved in the program. The evolution of increased contractor responsibility raises many serious questions about total package procurement. Foremost among them is the question of whether profits are or will be commensurate with the increased risks. The second major question concerns the management and control of new weapon system development. An additional concern is whether the profit motive has stifled innovation and product quality. The fourth consideration is whether the contractor can assume total system responsibility when the government has the ultimate risk of system performance. Finally, it must be determined whether logistical support requirements can be meaningfully defined at the outset of development, considering that in the end, the cost of operation and maintenance of a system can cause premature obsolescence.

In the discussions that follow, it must be recognized that it is difficult to separate the factors of contract definition, fixed prices, and incentives from the effects of total package procurement.

Risks versus Profits

Without exception, all interviewees indicated that the trade-off between risks and profits was essentially a one-way street, with the government directing traffic. While agreeing to increased contractor risks, neither party had evidence of potential increased profits. In fact, the prospect of increased risk indicated to the interviewees that profits might in fact be lower. Initially, target fees were perhaps no greater than fixed price

incentive development-only contracts, and in some cases no greater than CPIF contracts. Although increased risk is expected to be tied to incentives, it appears that incentives are providing lip service to meet some government quota rather than the dictates of increased risk. There is widespread consensus that increased contractor risk is not accompanied by fewer government administrative and auditing controls.

To better grasp the rationale contributing to the above observations, and more importantly to understand the profits that might be realized in total package procurements, one must examine the method by which the initial price is achieved, the influence of long-term commitments, and the relationship of incentives and higher contractor risks to increased profits.

Target Cost

It was generally agreed that the TPPC provides a better price for both development and production, since it calls on prospective contractors to sign binding contracts prior to development. The price is better to government because of price competition during Phase C of contract definition, and more importantly, because of elimination of the iceberg procurement which is prevalent in development-only contracts.

Development-only contracts do not encourage the contractor to provide adequately realistic or comprehensive production cost information. The total package concept induces more consideration and

assessment of production costs. Since ultimate production costs are generally higher than development costs by 4 to 1, there is no question that the government benefits from a better initial price with firm commitments on both development and production. Interviewees were quick to caution, however, that the price commitment may not hold if the system is pulsed by many changes, thus permitting any contractor to "get well." Contractors further cautioned that highly competitive pricing may lead to a net result of second-rate equipment, with quality suffering. Government people, realizing the fierceness of price competition and recognizing that system quality might be at stake, indicated that the initial price may not be enforceable and will deteriorate to field a weapon system with proper performance.

Even with a contract definition phase, work statements almost inevitably fail to articulate with any real clarity, how much risk is involved for advances in the state of the art. Defense-oriented firms hungry for business, willing to gamble, and competing fiercely in price and performance for systems requiring advances in the state of the art, can at best make only an educated guess of their true costs. Contractors faced with possible losses, total system responsibility, and unmeasurable mission performance parameters may tend to reduce quality unless the government agencies recognize the deterioration early and permit the contract to change.

Price Collusion

There is certainly no evidence of contractor collusion in establishing target prices. One reservation expressed by an SPO was that "If a competing contractor has an in-house contract for developing a similar weapon system for the same service agency, particularly under cost reimbursement, many of the development costs for common facilities, test apparatus, and personnel, may not be segregatable, thus redeeming some of the costs of a fixed price system under an in-house CPIF program." Secretary Charles, quoting a source that criticized government contractual practices, stated that "The kind of collusion that exists is not exactly a criminal conspiracy, but rather a kind of implicit gentlemanly agreement which keeps cost estimates at the high, risk-cushioning levels that have become normal and therefore legitimate business."²⁹ Such statements must be conceived in ignorance, for it appears that contractors establish their initial target cost well below the expected cost of the system.

Target Fees

The real target cost for the contracts studied was closer to a 6 per cent fee rather than the 9 and 10 per cent fees that were stipulated in the contracts. This information is not contractor privy data, but was recognized by Air Force procurement officials of all levels. In effect, it indicates significant departures in practice from the spirit

²⁹Robert H. Charles, "Remarks by Robert H. Charles," (Institute on Government Contracts, sponsored by the Southwestern Legal Foundation), p. 3

if not the letter of the ASPR regulations which provide guidelines for establishing fees within the statutes (fixed price incentive guides are used in the TPPC).

The ASPR regulations charge the contracting officer with the primary responsibility of procuring goods and services at the lowest possible total cost to the government. The drawback of this system is a tendency to apply a universal fee and ignore the individual characteristics of programs. As indicated earlier, CPIF contracts have been awarded with the same target fee as total package procurements. Admittedly, it is very difficult for contracting officers to choose the proper fee structure appropriate for each situation. Through experience, they have generally arrived at a profit or fee rate well below the maximum permitted, but high enough so that the contractor will accept it. They use these few rates over a long period for all contracts they negotiate. As changes are introduced into the program, the fee is gradually decreased; thus, the contracting officers are established as good negotiators, and reports to seniors reflect this. The advantages of such fee establishment practices are:³⁰

1. the contracting officer is under little risk of spurring an investigation by the General Accounting Office if the rate is stable and trending down;

³⁰How Sick is the Defense Industry?, Arthur D. Little, Inc., p. 30.

2. the contracting officer's superiors (who are in a poor position to evaluate the reasonable nature of costs) are pleased at what appears to be hard bargaining; and
3. the contractor feels some sense of continuity, since the fee he receives today may be better than earnest negotiation on each contract change might yield tomorrow.

Model Contract

As previously mentioned, a Request for Proposal contains a model contract which is negotiated during Phase C, with stipulated fees, sharing ratios, and ceiling prices. The competing firms can either accept the contract as it stands, or make formal exceptions to it in the response. The differences are then negotiated as competition continues through Phase C, avoiding the time-consuming process of having to perform this lengthy operation after source selection. The model contract also suggests incentives, but contractors are asked to consider the area that would be of most importance in spurring increased effort and performance and to submit alternate proposals. Most often, contractors do not submit alternate proposals and accept the structure as presented by the Air Force. Industry commitment to a binding model contract prior to the award decision has meant increasing examination of the contractual terms by industry executives. As one Air Force officer put it, "More executives are now reading

contracts before they are signed and this is a healthy development."³¹

Realizing that the formal fee structure is fictional and bears no resemblance to the contractor's actual perception of an initial target fee, industry has petitioned procurement officials to allow the fee to remain open in the RFP, and to be designated by the competing contractors. This attitude has been generally accepted by government interviewees of all levels; however, new contractual documents to not seem to be following the mutual recommendations.

In addition to leaving the fee structure open to bidders, there is indication that the cost sharing and ceiling terms should also provide more latitude for the bidding contractors. Some senior-level government procurement personnel indicate that wide latitude of this nature may complicate the source selection process and effectively remove a common base for selection. One senior procurement official indicated that the fee could be specified by the contractor, but that the ceiling and share line should be specified in the RFP; however, contractors should be required to bid on alternate terms rather than leaving it as an option. Although there is disagreement as to whether ceilings and sharing ratios should be specified, there is concurrence that the fees should not. Sharing ratios and ceilings will be discussed later.

³¹"Air Force Moves to Streamline Contracts," Aviation Week & Space Technology (Mid-December, 1967), 31.

The contract administrator of one firm indicated that participation in a total package procurement has given him enough experience to feel that bidding on future total package programs would place his company at a disadvantage. "Total package experience," he says, "gives the contractor a better feel for what his expected risk should be in terms of sharing and ceiling, as well as the real fees to be realized at the outset of a program." If an RFP contains stipulated fees, sharing, and ceilings, the firm would have to manipulate cost estimates to present a fictional picture with regard to the structured fee and sharing arrangements. Thus, the experienced bidder may be at a disadvantage to a new bidder (without experience in the total package concept) who, through risk naivete, will present his cost proposal according to government dictates, thus presenting a target cost which is essentially buying-in to a program with severe risk implications.

Buying-In

In the past, winners of development-only contracts frequently were awarded follow-on orders for production and support. It was not uncommon for contractors to be persuaded or convinced to "buy" the follow-on order by submitting development bids such that the resulting award could only produce poor financial results for the contractor. This fact is well known to experienced defense contractors as well as government buyers. The resulting economic effects of such practices are not wholly or partially attributed to the defense industry or the

government buyers, particularly when goals for contracts have been established by DoD procurement levels through service competition. In addition, contracts have significant controls and multi-reviews of the profits during the course of the program.

The total package concept is an attempt to define and firm up as much of the follow-on procurements as possible with the initial contract. Firm commitment to cost on production units at the outset of a program attacks one aspect of buying-in; however, there are other aspects that remain even with the total package concept. As pointed out by many of the interviewees, the TPPC limits, but does not prevent, buying-in at a sacrifice of initial profits.

First, if the system development has a commercial or foreign military application, this potential market is a definite factor. If it has a profitable commercial prospect, the contractor can lock out the overall market by keeping the production line going. On the C-5A, military follow-on alone is expected to have at least a 70 per cent growth. Government buyers feel that exercising firm options on the production aspects of the SRAM contract could be a problem negating the advantages of the total package.

Second, in volatile programs, even though they may not have commercial or foreign military application, contractor insight into the problems might encourage buying-in on the anticipation of changes.

As one program manager interviewed put it, "If government requirements are likely to change, then the total package concept is as good a vehicle as any for buying-in." On his program, the government contracting officer expected that the contractor had a 50/50 chance of meeting his target cost at the outset, with less than a 50/50 chance two or three months following contract award.

In all three programs studied, Air Force SPOs suspected that the awards went to contractors who bought into the program. This buying-in reflected an inability of the SPO to:

1. define the statement of work requirement so as to negate or minimize any changes,
2. define the total program government commitment requirements,
3. define the difficulty in exercising firm production options, and
4. accurately determine real target costs (contractor pressure to bid low or go out of business).

A glaring example of buying-in is an Air Force TPPC propulsion system award. This award was considered a total package award, but was not included in this study since contract definition was waived. The award was made to one of three competitors whose price was less than 50 per cent of its competitors' and Air Force estimates. The award was made without the benefit of a contract definition phase,

since all the required technologies were deemed to be well in hand.

In fact, a prototype of the system was developed and tested prior to the award of the contract. Assessment by the selection board indicated that the contractor had promised performance in excess of the RFP minimum, and the award was made to the lowest bidder over the objections of the technical assessments of the evaluation board which claimed that the ultimate proof of the weapon system's capability could not be demonstrated except under operational conditions, which -- due to the nature of the system -- could not be accomplished.

The Air Force concluded that the winning contractor was willing to promise performance minimums in excess of the work statement, that the program deliveries would be made in accordance with the prescribed schedule, that tight defense money due to increased Vietnam expenditures favored lowest cost, and that schedule restraints precluded the re-establishment of a model contract to which the offerers were already committed.

Significant performance incentives, negotiated at the outset, have diminished to par through the development of the above system. The contractor, intending to fulfill delivery schedules on time, is claiming that the dates will be met at financial loss. The SPO, recognizing that the strategic forces will not be prepared to accept delivery of the subsystem for close to a year beyond contractually required delivery, are afraid to slip the dates for fear that the contractor will slip

through many changes and thus get well on his under-bid development/production order. The SPO has clearly indicated that it is neither satisfied with the contractor performance nor can it move to provide relief due to the tightly written model contract, and that any changes in the contract will allow the contractor to get well and set a poor example for the concept. The Air Force is so firmly committed to the rigid inflexibilities of the total package procurement concept that the SPO would like to recompete production quantities with the proper delivery schedule rather than exercise the firm production options to which the development contractor has committed himself. This action, of course, would lead to severe criticism in DoD procurement circles and would undermine the philosophy of the total package concept. Nevertheless, this attitude prevails at the SPO, which is conditioned by its responsibility to field a reliable system with high confidence.

One additional aspect induces the defense contractor to buy-in to programs, TPPC included: to gain or regain participation in new defense programs. As indicated earlier, the total development cycle for major weapon systems is eight or more years. If a contractor has successfully won one of these programs and has been unsuccessful in the interim, toward the end of the development cycle of that weapon system he becomes quite hungry, and is willing to recover his defense business by committing whatever resources and stipulating whatever price may be necessary to gain a foothold. The expectation would be

that in the long run, some reasonable financial return would be realized.

The strategy employed by defense contractors to regain entry into new programs is colorfully referred to as "brochuremanship," and is described by the following statement of Peck and Scherer:

Quite commonly, this strategy includes submitting proposals which in one or more aspects are highly optimistic. Indeed, propensity to buy into attractive new programs with optimistic quality, time, and/or cost estimates is perhaps as much an industry practice in advanced weapon systems acquisition as list price cutting is in automobile retailing, or as the advertising of loss leaders is in department store operation.³²

This statement is particularly applicable to cost reimbursement contracts; however, there is evidence that it remains applicable in fixed price TPPC contracts.

In spite of DoD effort, primarily on the part of former Secretary McNamara, to streamline defense contracts and eliminate or at least reduce buying-in, the Pentagon continues to come under Congressional pressure to forbid contractors from engaging in this practice.³³ A great deal of this pressure, however, is not directed at DoD procurement policies, but rather to Secretary McNamara, who arrived at a great majority of decisions without Congressional consultation.³⁴

³²Peck and Scherer, op. cit., p. 412.

³³"Defense Contracts Under Fire," Business Week (July 29, 1967), 32.

³⁴Michael Getler, "McNamara Methods Arousing Fresh Criticism in Congress," Missiles and Rockets (January 17, 1966), 15.

Technological Risk

Theoretically, one can argue that contract definition provides boundaries for the state of the art, establishing the cutoff point for use of the total package. In practice, the results of contract definition as specified by DoD Directive 3200.9 have not been realized. To get into the winner's circle for a TPPC contract with all the necessary technical building blocks, a contractor would have to spend CD funds far in excess of his present level. The target costs upon which he bases his proposal would be realistic; however, the funds required for CD over and above the government-funded effort could well diminish to zero any profits that might accrue under a realistic target cost estimate.

Both Air Force and contractor personnel indicated that for the SRAM and Mark 17 programs, all of the technology was not in hand and some was in its infancy. The technological risk went far beyond defining interfaces of the system. On the Mark 17 program, the contractor uncovered changes in the state of the art resulting from sophisticated vulnerability and hardening analysis, which led not only to increased financial risk but also to criticism of technical reputation. Lack of system definition at the conclusion of Phase C of contract definition was evident in the fact that the Mark 17 contractor received a contract change redefining the system requirements at the date of award of the TPPC contract.

The SRAM program was developing a weapon system to interface with the General Dynamics FB-111 (bomber version of TFX fighter plane) and for late models of the B-52 strategic aircraft. A debate within the USAF and the Defense Department as to which carrier would be used with the SRAM led to contract provisions that could be withdrawn without upsetting the total package, should the decision be made not to employ the missile with the B-52. The final use of the SRAM missile remains something of a question mark. Marrying a missile to the FB-111 presented an interface problem broader than the technological risks involved in developing the missile itself. To define the SRAM missile, a "fabricated" interface was developed for the carrier aircraft, which was in concurrent development. The real interface was subjected to many changes during the program.

Prior to Phase C of the SRAM program, the SPO considered that the TPPC would be marginal for application, and in the summer of 1965 indicated that it would not be applicable to the SRAM program because of its operational dates and the fact that the interfaces and technology could not be defined well enough to prohibit vast numbers of changes to the program. The definition of the interface continued to deteriorate during Phase C, although it was not officially recognized.

According to the judgment of the SPOs and the contractors for both the Mark 17 and the SRAM programs, the threshold beyond which

the total package concept could be properly applied appears to have been exceeded. The pressures of meeting an initial operational capability seem to have paced the contract award. The programs should have been delayed for better definition, in accordance with CD instructions. (This would have delayed the programs by reopening them to competition at the end of Phase C.) Program performance requirements were undefined, yet procurement continued with a concept that was envisioned at the outset of contract definition competition.

Both contractor and Air Force procurement officials indicated that technology need not be 100 per cent off-the-shelf, but must at least be within grasp; furthermore, the threat against which the system would be deployed must be relatively constant. One contractor indicated that the performance of the system must be ultimately measured against the threat which it must defeat. Conversion of an enemy threat capability into performance criteria of a weapon system is extremely difficult. Contractors required to design a system against a threat criteria rather than its own individual system performance requirements face an almost impossible job, due to the many interpretations of what constitutes a viable threat.

Selection of Programs for TPPC

There are growing indications that the final state-of-the-art boundaries established as a cutoff point for the use of the total package

concept will be stretched well beyond the original concept as embodied in the C-5A contract (which was better defined than either the Mark 17 or the SRAM, yet is in fiscal trouble on target cost). Some Air Force officials say that it should be possible to apply the total package concept to any program in which enough is known about the end item to conduct a contract definition phase.³⁵ Secretary Charles says that "Programs that have been designated for the application of CDP are candidates for total package"³⁶ (underlining added). Other USAF procurement officials believe that even if no firm concept of the total program is available before the contract definition phase, it should be by the time CD is near completion.³⁷ These statements assume that contract definition completely defines the system, in accordance with DoD instructions. This appears to be far from the actual situation. SPO procurement officials seem to be unalterably committed to the TPPC during formulation of the RFP for contract definition. Their commitment appears to be solely responsive to a higher level procurement edict.

Senior USAF procurement officials indicate that this is a problem of communication which unfortunately has not been solved. However, there was no evidence of any programs being candidates during the CD

³⁵"Controversial Total Package Plan Tested," Aviation Week & Space Technology (Mid-December, 1967), 27.

³⁶Personal communication, February 28, 1968.

³⁷"Controversial Total Package Plan Tested," Aviation Week & Space Technology (Mid-December, 1967), 27.

phase. The type of procurement is locked-in upon issuance of the RFP, and regardless of the consequences and the nature of the proposals received as a result of CDP, the SPOs gave no strong consideration to the type of program procurement subsequent to the receipt of contractor proposals. The question of whether the TPPC was appropriate for use as a result of receiving contractor information in a defined technical work statement, model contract, and performance specification, was not a priority subject during Phase C negotiations. Therefore, the candidacy of the program as a result of CDP was a foregone conclusion, since it would be very difficult to change from TPPC following contract definition. It appears that lack of communication between SPO procurement levels and USAF procurement levels has led to the award of high-technical-risk TPPC programs on the assumption that the contract definition phase has adequately assessed the technical risk in the state-of-the-art development involved, from both technology and performance aspects. One Air Force procurement officer interviewed stated "It's easier to go along with your boss' desires than to develop arguments why you can't."

The response at the Defense Department level to the Air Force total package concept has been favorable. One article quotes John M. Malloy, Deputy Assistant Secretary of Defense for Procurement, as saying that the technique should be "very good when applied properly." He adds, however, that:

The results also could be bad if the concept is improperly applied. A case in point would be an attempt to impose a total package contract on a development program for a piece of hardware that is well beyond the current state-of-the-art. In such a case neither the military nor the contractor has any real knowledge of what the eventual costs of performance will be, or whether the end item should even be ordered into production.³⁸

These comments are particularly acute when one considers that the first production option for the SRAM program has not been picked up by the Air Force. The second production option has been delayed, and the FB-111 fighter bomber (the carrier aircraft) is in trouble regarding performance. Mr. Malloy's remarks have additional relevance since the Mark 17 program was cancelled after a multitude of design changes were imposed on the contractor and after almost two years of development, with escalated target costs.

Long-Term Commitment

Inherent in the total package concept is a long-term contractor commitment of resources. Commitment of vast corporate resources to a single program may be a blessing in long-run production planning, but has its dangers when one considers the fluctuations of the national economy, changes in government laws and regulations, and long-range overhead projections. The dangers are amplified in the event that the contract is terminated at the convenience of the government.

³⁸Ibid., p. 26.

Facilities and Termination. None of the contracts studied provided for additional government-furnished facilities in the RFP. This led to increased contractor investments to produce the systems. Not only were routine facilities committed to the project, but additional facilities had to be provided. DoD policies indicate that even without the total package concept, contractors should be encouraged to use their own money for routine general-purpose facilities. This, of course, does not apply to specialized-use facilities or special one-shot types of equipment. Contractor-provided facilities create special problems in the event of contract closeout. On terminations, Secretary Charles indicates that contractors may be allowed non-recurring cost which would have been amortized over the entire program. The amortization of cost must be approached with caution, however, since the contractor may have bought the facilities in anticipation of follow-on contracts (whether total package procurement or not). Nevertheless, in terminations the government should pick up the percentage of the amortized cost of routine facilities. Contractors, however, may require some extra incentives for committing routine facilities, particularly in the event of contract termination.³⁹ The argument that depreciation tax allowance would be a sufficient incentive does not seem to be applicable.

³⁹Personal communication, February 28, 1968.

Whether or not the government provides facilities is better determined by net profit or total capital investment returned on defense contracts -- which is considerably higher than the return on sales, yet sufficiently below corresponding ratios for the defense contractor's commercial business. This aspect of profit and return on capital investment, receives the most criticism from Congressional sources and will be discussed later.

Future procurements will require a definite increase in the magnitude of investment by contractors wishing to compete in the defense market. Businesses will have increased cash demands brought on by the higher cost of facilities and the retracting of government-sponsored general-purpose facilities -- neither of which is caused by the total package concept. The one aspect of total package procurement that does affect capital investment is contract termination. It will be difficult to determine whether a general-purpose facility was undertaken explicitly for the TPPC program at hand; and if it was and was shared with other in-house programs, it will be difficult to determine the proportion of that sharing which was on the total package contract.

Government allowance of amortized cost on routine facilities will be further complicated in the event of a terminated contract which is suspected of overt target cost at the time of termination. Overt target cost, however, begs definition, since in total package procurements a

contractor may overspend the R&D portion of the contract in anticipation of greater production profit savings by introducing manufacturability and low cost production at the expense of development money. Thus, the expenditures are shifted to the early phases of the program. This argument can be readily defended by contractors, and it would be difficult for the government to negotiate a total package procurement termination on other than a cost reimbursable basis with a negotiated fee structure. Allowable costs under this type of settlement will still be subject to a determination of the portion of routine facility investment applicable to the terminated contract.

Production Options. Long-term commitments are complicated by firm fixed price options. The TPPC contracts include a selection of production options to provide a base for both the government and the contractor to renegotiate costs based on previous experience. Before exercising the option, the responsible contracting officer tests the market to confirm that the quoted price is still a competitive one. If he finds that it is not, he can renegotiate the clause even if it means going to a separate letter contract to get the follow-on production underway. In this case, the contractor runs some risk of finding himself at a greater disadvantage. However, one Air Force procurement secretary indicates that renegotiation of production options also provides built-in protection for the contractor in the event that costs are exceeding the ceiling.

It was mentioned earlier that the initial contract for Boeing's SRAM program did not include any firm government commitment for production, but rather included three different options for production. The government was undecided as to the air carrier application of the SRAM missile, and therefore considered several options for tying a contractor down to a firm price commitment at the outset of development. The carrier vehicle was not defined -- although the prime carrier was to be the FB-111, later model B-52's were also considered as the host vehicle. The missile was to be developed concurrently with the flexible interface of the air carrier. FB-111 production quantities were also flexible, and subsequent to award of the SRAM contract, the numbers were increased.⁴⁰ Very recently, Congressional leaders have questioned the entire feasibility of the FB-111 program, and are directing their efforts toward cutbacks in production.

The Vice President of Government Contracts at Boeing questions the application of a total package procurement to marginal situations. He indicated that the use of options rather than a firm commitment for initial production lots reflects a significant degree of uncertainty, which may effectively lead to nullification of the motivations on which the concept is based. He poses the question "What might be the government's problems if the firm option prices were to appear

⁴⁰"FB-111 Procurement to be Hiked by 25%," Technology Week (September 19, 1966), 19.

demonstrably higher than current recurring cost estimates or if it should fail to exercise any of its options where the price was clearly below costs?"⁴¹

Economic Escalation. Another consideration in the long-term commitment is the escalation of the national economy. If the economy entered a period of inflation, the cost of doing business could seriously erode the profits expected by the contractor under conditions that are clearly beyond his control or prediction. To guard against such externalities, a corridor for economic fluctuations is provided by which the contract target price would be revised if a change of large magnitude (twice normal) were to occur. The corrections to target price would not be made in small increments, but would be made over long periods of time using as an index certain Bureau of Labor Standards statistics. Contractors indicated, however, that the causes of economic changes are subject to so many interpretations that it would be very difficult to levy an appropriate target price change based on the economy clause.

One additional external consideration upon which the contract target price is made is the world situation, since unforeseeable forces such as the Vietnam commitment not only reduce the amount of money available for necessary changes, but also make

⁴¹Howard W. Neffner, "New Methods of Large Systems Procurement," (address delivered at the NSIA Procurement Symposium, Washington, D.C., September 28, 1967).

it difficult to obtain the necessary priorities for material procurement for program development. This situation has forced Lockheed into foreign markets for engineering talent and parts. As a result, testing on the C-5A has been accomplished without the right parts to meet schedules. The contractor claims that these uncontrollable events have had a major impact on costs.

Post-Contract Audits. The length of TPPC contracts may cause serious problems in the final audit and settlement of the contract. The number of facts which must be retained by the contractor to justify allowable costs in final auditing has always been a problem, but will definitely be aggravated by the total package concept because contracts will have periods of performance of ten years or more. Independent government auditors not familiar with day-to-day operations of the program may have different views as to how much substantive backup data is required to support a position or change that has occurred during the program. Although no procedure is presently in progress, there appears to be a need for a procedure to close out and settle portions of a package during the course of the contract.

There is little hope of meeting the short-term cash requirements from return of operations on total package procurement. Therefore, it appears that defense industries will increasingly diversify into commercial businesses to provide sufficient funds and cash flow to operate the defense contracts.

Incentives

Since profits in the aerospace defense industry form such a narrow band -- too low for good performance, too high for bad performance -- the total package concept embraces the principle that efficient contractors will be rewarded by increased profits in return for the greater risk. These profits will be on the basic negotiated target fee and the accrued profits from properly operating incentives.⁴²

As conceived, the total package concept was intended to motivate contractors toward increased risk with the opportunity of achieving greater profits. Earlier discussions indicate that the initial target profit is not a real one, in that it is diluted by what the contractor actually expects to meet as a target cost. Many studies on incentive contracts have used the initial target cost and target fee as a basis for determining the efficiency of incentive contracts, and have neglected to consider that overruns and underruns on the target cost are imaginary. Considerations must be given to the real target profit anticipated by the contractor and government, and not the target profit negotiated into the contractual terms. Although this section will not fully explore the implications of all incentives on various types of contracts, the major studies on the use of incentives will be reviewed, and some of the conclusions of these studies will be compared to the comments received by both contractor and government interviewees.

⁴²Robert H. Charles, Total Package Procurement Concept (February 18, 1966), p. 3.

Several legislative committees have expressed considerable doubt about the wisdom of incentive contracts, yet neither government nor industry has been enchanted with CPFF contracts as a way of life. The aerospace companies have indicated that they are unable to negotiate satisfactory profits under CPFF, and would prefer to assume risks in return for greater profits, despite the protection afforded by the cost reimbursement aspects of CPFF. Reliable statistics on the return or profit rates to the aerospace industry are not available; however, ASPR guidance and statutory regulations provide for higher negotiated profit rates under fixed price work.

CPFF Conversions. Although contractors have been reluctant to reveal cost data and profits under the various types of contracts, many studies have been undertaken to relate cost to performance. One study reports on some of the cost differences observed in CPFF and FPIF contracts.⁴³ The analysis compares management cost to the contract type with management cost estimated alternately by cost overrun (over the original estimate), and by the sum of overrun plus contractor fee. The data examined permit no definite conclusion on the relative desirability (even in terms of cost alone) of the two types of contracts. The data do suggest that significant cost savings cannot be achieved merely by writing what otherwise might be a CPFF contract as an

⁴³ Alfred Blumstein, Management Costs in CPPF and FPIF Contracts, Institute for Defense Analyses (Technical Note TN-62-53), September, 1962, pp. 1-10.

FPIF contract, especially in those cases where cost estimation is difficult.⁴⁴

Another study investigated the conversion of R&D CPFF contracts into incentive contracts.⁴⁵ Its conclusions are essentially the same as the MITRE report. Some of the conclusions appear to have relevance to more than R&D incentive contracts:

1. Contractors avoid risk by some combination of stalling and allowing time to reduce technical uncertainties.
2. Little evidence is found that would support the assertion that contractors alter their behavior to seek greater profits.
3. Losses on incentive contracts are highly motivating and may lead to harmful shortcircuiting, particularly if ceiling costs are threatened.
4. More management attention is directed to changes on incentive contracts than on cost plus fixed fee contracts, suggesting that the contract outcome is more a result of negotiating skills than attention to the operation of contractual incentives.

Further exploration of contractor motivation under incentive awards was conducted by NASA.⁴⁶ The survey indicated that, insofar

⁴⁴Ibid., p. 10.

⁴⁵E.B. Roberts and J.B. Sloat, "Effects of Incentive Contracts in Research and Development: A Preliminary Research Report," IEEE Transactions on Engineering Management (December 1966), pp. 181-187.

⁴⁶"Incentives Prove Useful, But No Cure-all," Aviation Week & Space Technology (July 13, 1964), p. 31.

as technical personnel are concerned, no attempt is being made to direct their attention toward doing a better job on incentive-type contracts than on other types. In addition, the principal beneficiaries of financial incentives tend to be top management personnel, who now participate in profit-sharing bonuses. The survey also points out that the dialogue between technically-oriented and business-oriented personnel is increased -- an important by-product of incentive contracts.

Project managers, in directing incentive contracts on development programs, have been increasingly supported with financial and administrative aids to provide a closer monitoring of contract activities. It appears that this trend will increase since contractor senior management is becoming more and more interested in projected profit rates that might be the outcome of incentive contracts and, in fact, are continually revising their estimates to determine the actual fee expected. It becomes increasingly difficult to assume that the behavioral patterns of those working on production aspects of TPPC contracts will be altered or motivated toward the incentive provisions of the contract. It is highly unlikely that the shop foreman or the lathe operator has any idea of what type of contract he is operating on and what practices could lead to the maximization of incentive rewards. The most highly motivating factor in production is to deliver a product in accordance with the pre-designated schedule. This schedule is

often met at the cost of increased inefficiencies without comprehensive analysis of the tradeoff between schedule delivery penalties and cost sharing incentives. The motivating factor in presenting deliveries on time regardless of financial outcome is contractor reputation.

Multi-Incentives. Incentive contracts have become so fashionable that multi-incentives are provided on many contracts. These incentives cover cost, schedules, and performance. The C-5A program had a combination of these, plus a special provision which allows the contractor to increase his risk by assuming a greater portion of over-target cost with the potential of receiving greater profits. The uninitiated reader is directed to a report by the Incentives Analysis Company, which describes the techniques of administering various incentives.⁴⁷ The present evaluation will be limited to those incentives which are common to the three contracts under study.

Sharing Ratios. The most significant incentive is the sharing ratio negotiated along with the initial contractual terms of target cost, target price and fee. The establishment of cost sharing incentives is based on two defense procurement policy assumptions: 1) defense contracts are more uncertain than production contracts in the private sector of the economy, and 2) firms demand risk premiums that are positively correlated with contract risks. Risk aversion has led to

⁴⁷R. M. Jacobs, "Incentives in Government Contracts," Incentives Analysis (October, 1962), 1-105.

the development of cost sharing incentive contracts. In these contracts, the seller submits a target cost estimate. If actual costs are less than target cost, the seller receives a fixed percentage of the profits, which is the difference between the actual and the target cost. The remaining profits go to the government. The converse is true when actual costs are greater than target costs. A sharing ratio of 80/20 indicates that the buyer would bear 80 cents of each dollar of cost over the target, and the seller would bear 20 cents. Conversely, the buyer would retain 80 cents of each dollar cost under the target and the seller would receive 20 cents. On some contracts, such as the C-5A, two separate sharing ratios are specified -- one for overt target costs (70/30) and one for undertarget costs (50/50). The undertarget cost sharing ratio is more favorable for the contractor. In any event, all actual costs are limited by a ceiling which is a fixed percentage over the target costs and beyond which all costs are borne by the contractor.

Two independent studies were published in September, 1966 on the relationship of cost incentives to the efficiency of defense contracts. Surprisingly, both studies concluded that cost incentives are probably not very effective.

The RAND study,⁴⁸ sponsored by the Air Force, was an empirical analysis of 252 Air Force incentive contracts during the period 1959

⁴⁸K. L. Deavers and J. J. McCall, Notes on Incentive Contracting, RAND Corporation, September, 1966.

to 1963. The later period covered in the report contained a greater number of fixed price incentive contracts, and the analysis indicates statistical evidence to suggest that the contracts with higher sharing rates were either more efficient or more risky (i.e., the relative differences between actual and target costs were not significantly different for the higher and lower sharing rates). The study further pointed out that differences in government and contractor behavior was noticed as they gained experience in incentive-type contracts. The implication was that many factors influence contract outcome, and much more complex economic models might be required to secure better agreement between theory and experience.

An IDA study reported on four major contract types, covering completed Air Force contracts from 1959 through 1964.⁴⁹ In general, the study is limited to a comparison of CPFF and FPIF contracts. The observation by the Department of Defense that cost overruns have been far less frequent and less substantial under incentive contracts than CPFF contracts has been interpreted to indicate that cost performance under incentive contracts has been more efficient than under CPFF contracts. The IDA study concentrates on the extent to which simple cost overruns or underruns may serve as indicators of contractor efficiency. Several alternative interpretations of the DoD-observed relation of higher cost sharing rates and reduced

⁴⁹John Cross, A Reappraisal of Cost Incentives in Defense Contracts, Institute for Defense Analysis -- Economic and Political Studies Division, September, 1966, pp. 1-35.

cost overruns are presented in the report. The major empirical finding is that for a sample of recent Air Force incentive contracts with cost underruns and overruns, the percentage of overrun and underrun was negatively related to the sharing rate (the sharing rate is the change in fee over the change in cost).⁵⁰ Several additional hypotheses tested by linear regression indicate that inverse variations in the relationship identified above can be expected if target cost and profit are negotiable, and that the observed decline in overruns is attributable to an adjustment of estimated target costs. The final adjusted "target costs" which were used in the IDA analysis bear no relation to the initial target cost.

As a practical matter, contracts are modified several times during the performance of the work to take account of changes in the program, and the final "adjusted negotiated and definitized target cost" may not be fully determined until the project is well beyond the delivery of the last operational unit. This unclear definition of costs makes any analysis subject to skepticism, especially when analyses lead to the position that cost incentives are not very effective in rewarding efficient contractors. There has yet to be a study on incentive contracts which establishes any conclusive evidence that incentives are working according to the government incentive policy statements (i. e., to reward efficient contractors).

⁵⁰Ibid., pp. 6-7.

Flexible Incentives. In an effort to make incentive clauses more imaginative and flexible, the C-5A and SRAM contracts contained a special provision that at specified times during the life of the contract, the contractor is given the unilateral opportunity to increase his profits by assuming a greater share of cost overrun--and likewise to increase his share of cost underruns. The flexible incentive clause is explained in Appendix F, and is applicable to the C-5A airframe and engine contracts as well as the SRAM contract. The only contractor that has exercised the flexible incentive to date has been the C-5A engine contractor (General Electric). When contract target costs were close to 29 per cent (25 per cent being the minimum), G. E. "flexed" such that they increased their portion of the sharing--resulting in realization of initial target fee even if the target cost was overrun by 15 per cent. It is unlikely that the SRAM contractor will choose the flexible incentive clause, and Lockheed's C-5A flexible incentive was eliminated during negotiations after the final award.

Most government observers of the G. E. decision indicate that they were much too premature in spite of their computerized decision-making, and that they might regret the day they chose the increased risk. Indications are that Lockheed steered away from the flexible incentive clause in fear of being over the target price at the outset. Both contractor and Air Force interviewees indicated that the flexible share ratio lacks practicality. As one DoD procurement officer put it, "This

is primarily a gaming device--it is unlikely that either the government or contractor can be smart enough to predict their costs in order to gain full advantage of the flexible share."⁵¹

Flexible sharing was Secretary Charles' solution to more imaginative and flexible incentives, and he would like to see it applied more frequently. However, he indicates that its complexity may limit its practical use.

Performance Incentives. The contracts studied were multi-incentive contracts; that is, they contained cost sharing and performance incentives. The C-5A program contained a complicated performance incentive on productivity. The entire provision of this special incentive is contained in Appendix G. It was executed soon after the award of the contract with no change in initial target cost or target price, and was essentially a compromise among incentives initially considered. The value of this type of performance incentive cannot be underestimated because it is based on the real mission of the system and is measurable on truly operational equipment. The parameters of the productivity index are readily measurable and can lead to a calculable productivity index. However, Lockheed is concerned that one of the parameters contributing to the productivity index (weight empty, which is approximately 4,300 pounds over the initial contract target of 318,400 pounds)

⁵¹Personal communication, February 28, 1968.

will negate any realizable profit under the incentive provisions. Lockheed indicated that the stringent definition of the parameters, particularly the weight empty, is much too restrictive and does not reflect the practical operating situation. With agreement on this issue, it appears that the target value of the productivity index can be met and perhaps exceeded.

Despite the contractor's difficulty in meeting the target productivity index, the Air Force seems to be pleased with the "technical performance" on the C-5A program, and indicates that it will be within 1 per cent of the predicted value, and probably close to the value quoted in the contractor's proposal. A cumulative "performance index" is being maintained by the Air Force, comparing the progress and technical performance of the C-5A with Lockheed's C-141 cargo aircraft. An October, 1967 report to the Defense Industry Advisory Council (DIAC) indicated that, on the basis of the contractor's proposals, C-5A performance would be 9.3 percentage points better than C-141 performance. On the basis of the performance specified in the respective contracts, the actual performance on the C-5A is currently predicted by the Air Force to be 4.8 percentage points better than the C-141.

Performance incentives must be formulated to prohibit contractors from trading-off performance incentives against cost incentives. No indications of such trade-offs were evident on contracts studied; however, in structuring the C-5A contract the government limited

performance incentive rewards to 15 million dollars, in the event that Lockheed selected the flexible sharing ratio. Instead of selecting the flexible share option, the government chose a 70/30 overrun sharing and 50/50 underrun sharing arrangement, permitting the amount of performance reward to increase to 22-1/2 million dollars.

Performance incentives on the SRAM and Mark 17 contracts were not so closely tied to the mission of the system. Instead, they were tied to specific parameters contributing minimally to the overall mission of the system. Contractors felt that these performance incentives were generally fictional and impractical, and that their full impact is not available at the time of negotiations. According to contractors, they are generally resolved in an adverse manner, to satisfy whims and goals of senior procurement people. Traditionally, performance incentives have a way of disappearing by negotiating them at par value, particularly on programs requiring significant advances in the state of the art and therefore subject to multiple performance and specification changes during development. Negotiation of the first contract change on the Mark 17 removed all performance incentives. On the SRAM program, the single incentive--radar cross section of the missile--appears to be intact at the time of this writing.

One procurement officer, realizing that contractors have stated expected performance in their proposals in an environment of competition, indicated that "DoD never really expects increased performance

over and above the basic requirements, fully recognizing that the contractor has possibly been over-optimistic. Therefore, performance incentives are primarily to protect the cost incentives, which are much more meaningful."

Schedule Incentives. Schedule incentives, applied only to the C-5A program, are generally falling into disuse since it is very difficult to determine what in fact constitutes liquidated damages to the government. More important, it often becomes convenient for the government to have flexible schedules, to ensure that the using activity of the delivered item is prepared and ready to use it. Frequently, schedules must be shifted at the convenience of the government to ensure a timely arrival of companion systems to either test or use the system.

Too often, contractors expend considerable time and effort risking overtime cost to meet fictitious schedules, resulting not only in inefficiencies within the financial framework, but also in demoralized workers at the contractor's facility. Furthermore, it is very difficult for the government to negotiate schedule changes that might result from small performance or specification changes having minor impact on schedules. It is much easier to aggregate the changes to determine their effect on schedules. Frequently, in the aggregation of schedule impact caused by design or other changes, there is a built-in government reluctance to show contractual slippages caused by changes, since major milestones such as deliveries and target cost are scrutinized at

high levels. Major schedule slippages and target cost increases are perhaps the two items which receive the most concentrated command attention at the Air Force SPOs.

Contractors are most sensitive to schedule slips because failure to deliver a system into a network of aerospace associates provides tangible information reflecting on the reputation of the contractor to a greater extent than cost or performance incentives, which are shrouded by a general lack of conclusive evidence indicating contractor vulnerability.

Institutional Incentives. It appears that the extra-contractual (institutional) pressures are more significant and influential in contractor performance than the judiciously phrased contractual terms defining costs, performance, and penalties. Several cogent remarks on this theme were made in a speech by John R. Russell, consultant on incentive contracts for Harbridge House, Boston, Massachusetts. The full text of this speech was carried in Aviation Week.⁵² Russell comments on the various formal analyses and studies being conducted by college groups and consulting firms regarding the success of incentives. He concludes that these studies will indicate that incentives are not working and as presently applied cannot work. He provides four considerations for this observation:

⁵²"Attack on Incentive System Seen in Rising Debate On Contracting," Aviation Week & Space Technology (May 23, 1966), 119-123.

1. Businessmen, contrary to the assumption on which incentives are based, are not maximizers but satisficers.
2. The contractor is quite likely to act in a manner that would ensure the maximum life of his product during its production phase (very necessary to survive in the defense-aerospace environment).
3. Government incentive policy statements and directives which hold that good performance should be rewarded and bad performance penalized is too naive.
4. There is no conclusive evidence that incentives are working.

Russell continues his analysis of incentive contracts by indicating that the government has recognized most of the theoretical flaws and inconsistencies in policy statements. He feels quite sure that most proponents of incentive contracting recognize that, because of statistical uncertainty, rewards and penalties may not always be commensurate with actual performance.⁵³ This is not the kind of statement that can be made publicly by DoD. While the critics have found it easy to condemn incentives, the condemnation is primarily due to the fact that proponents of the incentive system have overstated its objectives. A more limited objective--an increased awareness of customer desires and an aid in the decision-making process--would create some understanding as to whether incentives are working or not and would make it extremely difficult to prove or disprove that incentives are working.

⁵³ Ibid., p. 123.

No set of statistics on cost overruns or underruns, rewards earned, or penalties sustained will really prove very much about the efficacy of incentives.

The theoretical assertions relative to increased contractor efficiency, motivation for increased risk, and rewards and penalties for contractor performance, compounded by statements indicating a 10 per cent savings on incentivized contracts, lead to glaring weaknesses in the stated government policies relative to incentives, and allow legitimate criticisms to be leveled by statistical studies against the practice of incentives. The true test of incentives is not whether they turn businessmen into ruthless pursuers of maximum fee, but rather whether they result in significant favorable changes in day-to-day management of projects. This appears to be happening.

Total Package Incentives. Many of the theoretical flaws of incentive contracts have been determined by analyses of development-only contracts. Total package procurement tends to eliminate one of these theoretical flaws: the contractor must make a total program commitment, including production, thus increasing his risk. According to the theory that contractors look for a satisficing long-term profit (i. e., production) rather than a maximum short-term profit (i. e., development), incentives should play a larger role in motivating contractors. This position is not consistent with some analyses, which conclude that the incentive principle must be abandoned altogether.

Whether or not the increased risk assumed by total package contractors will be commensurate with increased profits--realized through incentive contracts by so-called efficient contractors--will not be determined for a long time if ever. Contractors have expressed initial reactions concerning the possible profits accrued on total package contracts. Interviewees indicated that the requirements stipulated in the RFP on profit percentage, sharing ratios, and ceilings are much too arbitrarily set by the government, and should be left to the discretion of the bidding contractors. This seems to be the only mechanism through which contractors will approach realistic estimates of actual target costs. The confidence level of target costs would be demonstrated by a contractor-specified ceiling price, with risk adversity measured by the contractor-specified sharing ratio. An indication of the satisfying profits accruing to the contractor would be the fee that he is willing to accept on his target cost, providing the fee is specified by the contractor.

Contractors consider winning and holding a production contract far more important than negotiating an incentive provision on a development-only contract. It is to this end that the principle of incentives will have increased relevance in the total package procurement concept.

Profit Measurement

While defense contractors claim to be suffering secular declines in profits (return on sales), Congress is pressuring DoD to institute

better control and constraint on the profits earned by defense contractors. Contractors have contributed to declining profits by acquiescing to government demands--accepting cost sharing, surrendering proprietary information, and buying contracts--in their feverish efforts to boost volume, without due regard to profits and return. Definition of an adequate return is the perplexing problem facing the analyst in determining the proper profit participation of defense business. An early analysis of profits in the aerospace industry indicated that in 1961 the return on sales in the aircraft industry (2.2 per cent) was the lowest of the 21 manufacturing industries considered.⁵⁴ The same study indicated that the return on invested capital (also called net work or equity) was the third highest of the 21 industries (11.6 per cent).

A later study indicated that the return on equity to the defense industry was 5.8 per cent after taxes, compared to a return on equity after taxes of 9 per cent for all industry.⁵⁵ These percentages include a certain adjustment required to determine the weighted cost of capital (i.e., the rate of return that a company must show to attract the capital it needs). The adjustment was based on the average price-to-earnings ratio of eleven companies in the aerospace industry.

The government has continually maintained that the defense industry has a very high return on equity relative to all business. Some argue,

⁵⁴ How Sick is the Defense Industry?, Arthur D. Little, Inc., p. 54.

⁵⁵ Ibid., p. 71.

however, that return on equity and return on sales are irrelevant, and that a somewhat deeper analysis is required to determine what an adequate return should be for the defense (or any other) industry, including considerations for the cost of capital.

Defense versus Commercial Profits

In response to the complaints of falling profits and the present DoD policy of substantially reducing the amount of facilities furnished its contractors, DoD initiated a study of profits in the defense industry.⁵⁶ This study concentrated on determining the relationships between profit and the return required to generate the investment. Complete information regarding the amount of assets required to produce equipment sold is not readily available for the aerospace industry because of the substantial government facilities used by defense contractors, and because of the practice of leasing facilities. Leasing provides a better chance of recovering amounts paid for such facilities under cost-type contracts which are in-house at the same time incentive contracts are in-house. The study was further complicated by the fact that defense divisions of conglomerate corporations are reluctant to divulge financial information.

This research was conducted by the Logistics Management Institute (LMI) of Washington, D. C., a non-profit research organization, and represents the most comprehensive analysis to date. The results of a

⁵⁶ Defense Industry Profit Review, LMI Task 66-25, Logistics Management Institute, November, 1967.

twenty-month study were released in a two-volume report entitled "Defense Industry Profit Review," which was made public in February, 1968. This report finds that the profits of major defense contractors are lower than commercial profits of these and other contractors. Moreover, defense profits have been declining and remaining at a constant level while commercial profits have been rising. This is true of profits measured either as a percentage of total capital investment or as a percentage of sales. Since the LMI study appears to be the first valid independent research undertaken into the past and current earnings of corporations doing business under defense contracts, its summary findings are included here:

SUMMARY FINDINGS

A. COMPARISON OF PROFIT ON DEFENSE BUSINESS WITH PROFIT ON COMMERCIAL BUSINESS

(Note: The profit rates used in this Paragraph A are net profits after deduction of Federal income taxes.)

1. The average profit as a percent of capital investment, of high and medium volume companies, has been lower for the past five years on their defense business than on their commercial business and also lower than the average profit on capital of companies included in the FTC-SEC sample. The trend of profits on defense business of these companies since 1958 has been downward while that on their commercial business and the FTC-SEC sample has been upward.

--Net Profit on Total Capital Investment (TCI) was 6.9% on defense business in 1966. The corresponding ratio for defense contractors' commercial business was 10.8% and for companies in the FTC-SEC sample, 12.4%.

-- Between 1958 and 1966 defense profit/TCI ranged from a high of 10.2% in 1958 to a low of 6.3% in 1964 and stood at 6.9% in 1966.

-- Profit to TCI on the commercial business of defense contractors ranged from a low of 4.7% in 1961 to a high of 11.6% in 1965 and stood at 10.8% in 1966.

-- Profit to TCI of the comparable FTC-SEC industry groups ranged from a low of 7.5% in 1958 to a high of 12.6% in 1965 and stood at 12.4% in 1966.

2. Defense TCI turnover (the ratio of sales to TCI) declined from 3.8 in 1958 to 2.9 in 1966. Over the same period the TCI turnover of both the commercial business of defense contractors and the FTC-SEC companies ranged from 2.0 in 1958 to 2.2 in 1966.

3. Over the same period the defense business ratio of profit to sales declined from 2.7% in 1958 to 2.4% in 1966. In contrast, both the commercial business of defense firms and the FTC-SEC companies showed increases in profit on sales; the first group from 3.4% in 1958 to 5.0% in 1966 and the second group from 3.6% in 1958 to 5.5% in 1966.

4. The decline in defense profits on TCI was caused primarily by the decline in TCI turnover and to a lesser degree by a decline in profits on sales, which held a fairly level ratio from 1960 forward. However, the fact that commercial and FTC-SEC turnover and profits on sales increased steadily during the same period has resulted in a widening of the gap between defense profits and commercial profits on TCI.

5. The non-defense portion of defense industry business has been expanding at a slightly faster rate than has commercial business in general. The defense portion of defense industry business, therefore, has been declining as a percentage of their overall business.

6. Discussions with defense contractors revealed that most of them planned to increase their commercial business as a percent of their total business. They intend to change their commercial/defense business mix primarily by concentrating growth efforts on non-defense business. Their reasons are that:

- a. The non-defense sector of the economy is growing more rapidly than the defense sector and they believe it will continue to do so.
- b. During the past few years financial risk has shifted significantly from the Government to contractors in defense business.
- c. There is greater profit potential in commercial business.
- d. Commercial business is generally less competitive and has more production stability than defense business.⁵⁷

Total Package Profits

It becomes increasingly unclear as to where defense contractor profits will be derived. As already pointed out, the initially targeted cost is not representative of the actual expected cost, and therefore the initial target fee is not representative of what might be the return on sales for that particular contract. It has also been shown that incentives have not been proven conclusively to be rewarding efficient contractors. The competitive total package procurements studied indicate that neither the initial target fee nor performance or cost incentives will provide adequate returns for the increased risks assumed by the contractor in making a firm commitment for production.

Present indications on the C-5A program are that the contractor will spend close to \$400 million more than target cost, which places the expected profit between 4 and 5 per cent. Below 4 per cent, the

⁵⁷ *Ibid.*, pp. 11-13. Footnotes in the text are omitted.

ceiling takes over and Lockheed will be in serious trouble. Northrop Corporation, which is developing navigational systems for the C-5A, is also in trouble on its target costs (by about 10 million dollars), and is negotiating with the government and Lockheed to split up the overrun.⁵⁸ Thomas May, President of Lockheed-Georgia, indicates that changes are normal for a craft the size of the C-5A, and that most changes will save money down the line.⁵⁹ Lockheed interviewees are quite certain that the C-5A contractors have leaned out the window too far under the shade of competition, and that the only consolation in terms of corporate profitability appears to be the negotiation of second and third production runs and the high returns to scale derived from a long production run. There is one salvation, however, on the C-5A; the contractor has hope that a reasonable prorata share of development costs can be negotiated with the government in return for foreign and commercial sales. Present indications are that these negotiations have been completed for segmented portions of such sales.

Corporate top management is the only group that had hopes at the outset of achieving the profit objective. Middle management generally disagreed at the outset, and could therefore only lend discouragement to the actual performance. Much of the company's middle management considered the ceiling price to have been set much too arbitrarily by

⁵⁸News item in The Wall Street Journal, January 29, 1968.

⁵⁹Ibid.

the government, and that only filled coffers at corporate headquarters could prevent catastrophic bankruptcy. One individual indicated that there should be an additional exponential sharing ratio over the ceiling.

The profit picture on the Mark 17 and SRAM programs is much more difficult to ascertain. The termination of the Mark 17 program has essentially changed it to a cost reimbursement contract, because of the difficulty in determining if overruns were attributable to contractor inefficiencies or to the shifting of production funds into the development stage. The items of real controversy in settling the fee and target cost will be the determination of allowable costs. In light of the significant growth in initial target cost, government negotiators appear to be reluctant to consider the increased risk aspects of the total package procurement (for example, no government facilities were allowed on the contract, yet the contractor claims to have a vested interest in facilities based on the government production commitment). It appears that termination will be handled in accordance with the normal ASPR provisions, and that the resultant fee will strongly depend on negotiation skills in determining allowable costs rather than on any explicit measure of performance.

Profit indicators on the SRAM program are more difficult to determine. Although there has been significant growth in the basic development-only contract, many of the development changes affecting production quantities have not been negotiated for target cost. The profit

picture will depend on how well the contractor is able to negotiate the production option price impact of the development changes. The target cost appears to be in jeopardy. Controversy relative to the allowability of additional cost on one change has already led to legal dispute.

Most contractors indicated that they were forced to accept situations under competition which are not readily achievable, and that the award decision was not based on the context of the technical proposal but upon the difficult-to-resist negotiation pressures. The Aerospace Industries Association (AIA) has developed a technical subcommittee to address itself to three questions:

1. How does the industry set realistic schedules and technical objectives?
2. How do costs get assessed adequately?
3. How are technical integrity and costs traded-off?

This subcommittee will attempt to define the principles necessary to procure a weapon system advantageously on a TPPC/FPI basis.

One of the underlying motivations of this technical committee appears to be industry's conviction that the source evaluation board is incapable of properly assessing weapon system proposals, and should employ neutrals who have industry experience and who have been charged in the past with the responsibility for conducting similar programs. According to the AIA plan, these neutrals, along with the

government evaluation team, would establish the criteria for a defined contract and work statement, and would select those contractors capable of performing within the defined performance parameters. These contractors would bid on performance, strictly in terms of schedules and costs, with a determination of the award being made by the government's source selection committee.

Excessive profits do not appear to be a predictable outcome of the contracts studied. If in the very distant future, when the ultimate profit picture of the contracts is determined, a metamorphosis takes place which converts inadequate profits to excessive profits, a hierarchy of government regulations will recover the excess profits. Although all contracts are audited by government in-plant personnel during the performance of the contract, their authority is limited to the actual costs of the contract. The contractor is further subjected to General Accounting Office (GAO) investigation, which assures that public monies are spent efficiently and in accordance with the wishes of Congress. The final and unique risk that an aerospace firm runs in dealing with the government--especially on incentive-type contracts--is renegotiation. If the firm does particularly well in cutting contract costs, it must not only share a portion of its profits with the government, but a separate government agency (the Renegotiation Board) may sue to recover additional profits, thus effectively changing the sharing rate and the amount of profit that ultimately winds up in the bank.

The Renegotiation Board was created to ensure that no excessive profits are realized by prime contractors and subcontractors as a result of the continuing large federal procurement outlays for defense and space purposes. This goal is accomplished both by board proceedings resulting in ordered refunds of excessive profits, and by the voluntary action of contractors. Under the statutes, renegotiation is not conducted on individual contracts, but with respect to the receipts or accruals under all renegotiable contracts and subcontracts of a firm in each fiscal year. Arguments against the extension of the Renegotiation Act have been based on the contention that the Act is an obsolete law and that the decisions made under its authority are purely subjective and lack meaningful standards.⁶⁰ If Congress determines that the law be extended, one of the several amendments suggested in hearings before the Ways and Means Committee is that contracts in which incentive and competitive elements are introduced should be exempt.⁶¹ These hearings considered the results of the LMI profit study which indicated that excessive profits is not the problem in defense procurement. Since renegotiation considers all fiscal year renegotiable defense contracts, exemption of in-house contracts awarded under competition and incentive will require contractors to segregate their total cost as applied to these contracts. Contractors with a

⁶⁰United States Congress, House of Representatives, Committee on Ways and Means, Hearings on H.R. 14802 and Other Bills to Extend the Renegotiation Act of 1951, March 12, 1968 (Washington, D.C.: Government Printing Office, 1968).

⁶¹Ibid.

multi-mix procurement may find it very difficult to segregate the total cost and apportioned overhead costs, considering the various types of incentives (although one report indicates that allocations of overhead can be made for a company conducting business under a variety of contracts).⁶²

Recognizing that the total package concept requires government contractors to assume greater risk, Secretary Charles personally explained to the Board the nature of total package procurement, indicating that the Board should take into account the greater degree of risk. It is unlikely, however, that such accountability can be made when various types of contracts are aggregated on a fiscal year basis.

All indications are that defense profits--even under total package procurement and regardless of how measured--are generally lower than commercial profits. One can argue that the financial risk in defense contracting, compared with commercial business, is low; however, other risks pertaining to technology and reputation are relatively high. The worth of technological and reputational risk, in terms of profit to contractors, can only be measured by the number of contractors continuing to bid under fierce competition and extremely long commitments of resources. Unless the contractor has diversified significantly in commercial areas, the cost of capital required to

⁶²Arnold D. Carlson, "Overhead Decision-Making in an Incentive Contract Environment," (unpublished Master's thesis, Massachusetts Institute of Technology, 1966), p. 61.

finance government projects may exceed the return available, forcing them out of the defense business. It appears that financing of defense business is becoming increasingly more difficult, and firms will have to develop new ways of improving their return on investment and increasing cash flow while maintaining an acceptable level of risk. Such a position may lead to greater diversification of product mix, and to more selectivity in the acceptance of government programs--not only requiring significant investment to define the program, but also determining how to trade-off technical and reputational risk against a reasonable financial profit.

Management and Control

Prior to 1961, national security planning was fragmented among the services, as was systems procurement. New systems were initiated, procured, developed, produced, and introduced into the military inventory without formal regard for their total lifetime costs or their effectiveness in large interservice missions. While the Army was planning for a long war of attrition, the Air Force was planning on a short war of nuclear bombardment. Although either approach might make sense, both could not be followed in establishing coordinated strategic objectives of national security. Ironically, the United States still enjoyed a 4 to 1 strategic weapon superiority over its most probable enemy, the Soviet Union.

Procurement commitments were made essentially at the SPO level, and were relatively simple and flexible for each of the services and programs.

However, they left much to be desired in the areas of system performance and cost and schedule control. In addition, different systems complemented and supplemented one another only weakly. Service agencies were severely criticized by DoD and Congress when they requested additional funds to complete weapon system development programs.

DoD Requirements

When Robert McNamara entered the office of Secretary of Defense in 1961, he introduced a coordinated management reform which led to one of the most comprehensive management systems ever conceived-- generally called the Planning, Programming, Budgeting System (PPBS). Secretary McNamara's management philosophy focused on two basic management principles, which are discussed in the following paragraphs.

McNamara's first principle was to determine as accurately as possible what had to be purchased to support the integrated war plans. This principle essentially developed a joint strategic objective plan, pasting together the unilaterally developed service plans and relating them directly to the national security objectives in a five-year force structure document. While industry does contribute to the requirements generation and system analysis during the formulation and definition phases, the responsibility for execution of this principle clearly lies within the military services. It requires them to define requirements clearly and to refine their calculations such that they develop the

military force structure necessary to carry out the nation's foreign policy without regard to arbitrary budget ceilings and allocations for various services.

The total package procurement concept is a step in this direction, since it forces the services to think through a program to determine what it wants even before contract definition. The extent to which this discipline was exercised in the programs studied is questionable. Both contractor and SPO interviewees indicated that system thinking was generally at odds between the using agencies (SAC and MAC) and DDR&E. While the using agency looked for simplicity, early schedules, size and overwhelming strategic superiority, DDR&E looked for state-of-the-art advances based on either new intelligence information or more sophisticated technology. Contractors attributed the lack of resolution between the user and the system developer (SPO) to insufficient involvement on the part of the using command during the contract definition phase. As a result, the contract definition phase did not provide the necessary self-discipline with regard to performance definition and thinking through of the system.

Contractors on both the Mark 17 and SRAM programs feel that they had insufficient data available to make a tight enough system specification that would be insensitive to interfaces, intelligence, politics, and military budgets. Evidence of this lack of definition exists in the

significant R&D target cost growth of both the Mark 17 and SRAM programs, and more particularly, in the termination of the Mark 17 program.

McNamara's second principle was to buy the required weapons at the lowest sound price--a challenge to both industry and the military. The military is meeting its challenge by a shift from cost reimbursement contracts to competitive fixed price incentive contracts and multi-year procurements. TPPC is a further extension of the attempt to buy at the lowest sound price by requiring a firm contractor cost commitment not only for development but for as much of the total program as can be defined. The evolution of this second principle has led to a proliferation of management systems with their attendant reporting requirements. These management systems are perhaps the most discussed and least understood efforts of DoD. The thrust of the new management systems has been directed primarily to improve financial management by tying in costs, schedules and performance. The administration, so intrigued by this new approach in management, has directed that it be applied to departments other than Defense. This opportunity has been seized by the Bureau of the Budget, resulting in its greater role in the allocation of resources and establishment of administration priorities.

DoD's financial experts have also been quick to revise their reporting systems to meet the new objectives. Robert N. Anthony, Assistant Secretary of Defense, outlined a program to eliminate the inconsistencies

in financial management, focusing on operating costs. In a major speech before the Financial Management Roundtable he outlined three objectives: 1) to integrate programming, budgeting, and management accounting such that the information used in these three systems will be consistent; 2) to charge an organizational unit with 100 per cent of the measurable expenses; and 3) to devise a system that allows planning in terms of overall programs but managing by organizational units.⁶³

The evolution of the financial upheaval in the Department of Defense has led to a labyrinth of symbolic technical language and abbreviations describing the various management systems programs used in the Department of Defense. More recently, the defense community has been exposed to new nomenclature in the form of Resource Management Systems, Asset Management System, Selected Acquisition Information and Management Systems, Cost Information Reports, etc. The Air Force approach for developing an approved financial management system, which will satisfy the concepts and objectives developed under the Resource Management Systems program of the Department of Defense, is presented in the Defense Industry Bulletin of January, 1967.⁶⁴ This article describes the DoD in-house management functions and concentrates on the Selected Acquisitions Information and Management System (SAIMS), which requires close involvement with industry and is concerned with the management and support of weapon system acquisitions.

⁶³ Robert N. Anthony, "Closing the Loop," (address before the Financial Management Roundtable, October 25, 1966).

⁶⁴ Lt. Col. Hans H. Driessnack, "Air Force Participation in the Development of SAIMS," Defense Industry Bulletin (January, 1967), pp. 34-40.

The evolution of management systems has not occurred without significant problems. A clear, complete, and concise position on the objectives of government management systems appears to be essential to the resolution of some of these problems. To this end, the Council of Defense and Space Industry Associations (CODSIA) has attempted to develop jointly with OSD and NASA, objectives for the development and application of government management systems in the acquisition process. The recommendations of CODSIA were presented to the Office of Assistant Secretary (Comptroller), Department of Defense, on March 27, 1967.⁶⁵ A joint DoD/CODSIA advisory committee for Management Systems Control was chartered to make recommendations to the comptroller for reducing the duplicating and overlapping of existing management systems. Their final report was recently published.⁶⁶

Air Force Requirements

The Air Force Systems Command (AFSC) is also looking into management systems control problems with the Aerospace Technical Council (ATC) of the Aerospace Industries Association of America (AIAA). The Management Systems Control Board of the AFSC has had two objectives--controlling both the generation and application of management systems. At a meeting of this board and the ATC in

⁶⁵Objectives of the Development and Application of Government Management Systems in the Acquisition Process (a position paper of the Council of Defense and Space Industry Associations dated March 23, 1967).

⁶⁶DoD/CODSIA Advisory Committee for Management Systems Control, Final Report (March 28, 1968).

December, 1967, it was decided to conduct two reviews: 1) a direct examination of management systems affecting industry through a study of regulations, manuals, and associated data items, and 2) an in-depth probe of a major system of the past and a major system of the present, with particular emphasis on controls imposed by contractors. The results of these evaluations are not yet known; however, AFSC is in the process of preparing a principle paper for the guidance of these evaluations. This paper is designed to relate the contractor financial risk with the Air Force control and visibility aids.⁶⁷ Herein lies the major concern of industries with regard to the management systems imposed by the Air Force.

Contractors have been able to weather the storm of control requirements spawned by the various systems. However, the results have been less than the initially conceived objectives of the control system. This discussion will be limited to controls that contractors feel have been too stringently applied, without due regard for the stability of the program and the type of program (development-only, production-only, or a combination of both).

PERT. The Program Evaluation and Review Technique (PERT), a scheduling tool developed by the Navy, was applied across-the-board to many Air Force programs, and expanded to also provide cost data.

⁶⁷ Based on a letter from Lt. Gen. Charles H. Terhune, Jr. (Vice Commander, AFSC) to Mr. Carl L. Sadler (Chairman, Aerospace Technical Council, Aerospace Industries Association of America), dated November 20, 1967.

Contractor adaptation of the PERT technique to the detailed work breakdown structure required by the Air Force has made presentations of such information very complex. More recently, PERT has been limited to critical areas of the program and top-tier schedule milestones that are meaningful to senior management personnel. To the dismay of some Air Force people, indications are that on development programs, PERT has had no effect on technical performance, and that the reason PERT has led to improvements in schedule performance lies in the fact that those concerned with scheduling gain authority in this area.⁶⁸

Much of the contractor resistance to providing detailed PERT information is caused by the fact that schedule slips released to Air Force authorities produce too much consternation on the part of the government, without due consideration of slack times which might be used to recover the time lost. The fact that the slack is not reflected in the published schedules is aggravated by the untimely and inadequate feedback to the scheduler by those responsible for various work packages within the contractor activities.

Program Management Guidance. One of the most comprehensive manuals covering the management needs of systems programs is the 375 Series of Air Force Systems Command manuals. The manuals define the system program management procedures required to integrate

⁶⁸Wyckham D. Seelig and Irwin M. Rubin, The Effects of PERT in R&D Organizations (working paper, Research Program on the Management of Science and Technology, Alfred P. Sloan School of Management, Massachusetts Institute of Technology, December, 1966), p. 15.

all significant management actions necessary to provide a suitable system at minimum cost. The guidance provided by this series of manuals has been invaluable to both contractor and government SPO personnel. There are several inconsistencies, however, with the total package concept. One is the detailed SPO approval of specifications and various design reviews. The manuals not only require specifications to be approved in detail by the SPO but also require a format inconsistent with some of the system requirements of the contracts. For example, the Minuteman Weapon System has criteria for establishing specifications in accordance with prescribed exhibits. These criteria are redundant and/or in conflict with the end-item specification requirements of the 375 manuals.

An additional area of concern to contractors is that the manuals practically dictate the organization that must be established and the types of work packages required in developing a program. Contractors found that functional organizations required by the manual would be in conflict with organizations required for other functions of the firm. Furthermore, the Air Force work package breakdown did not fit into the firm's functional or administrative organizations.

Although the RFP of one of the contracts studied stated that the 375 Series of manuals should be used for total package guidance, it appears that the manuals have very little effect on the application of the

total package concept, but if selectively applied with the necessary revisions, they can be effectively used in the execution of any Air Force weapon system acquisition, particularly those less defined. It should be kept in mind that these manuals must be employed selectively, only to the extent that they serve the needs of the individual program.

Too often the government program director applies the manuals in total, without determining when departures are warranted and when waivers are required or desired to implement a particular type of program. This was evidenced in the three programs studied, necessitating numerous changes to the work statement. In addition to the inconsistencies between the manual requirement and the exhibits that exist to develop specific weapon systems, the data and management information provided to the SPOs by contractors under the 375 Series manuals is much more than needed, and in fact is more than they know what to do with.

Earned Value. One of the outgrowths of the 375 Series manuals was a requirement for contractors to report on their program in terms of earned value. Simply stated, earned value is an efficiency of the cost/performance of a particular contract at various points in time. Many of the contractors' internal management systems had to be completely revised to be consistent with the format for reporting earned value. The revision, although promising a better financial management

tool, does not appear to be providing real performance/cost trade-off information to senior program management personnel.

Data Submittals. Subsequent to contract award, contractors have been deluged with data requests by the program offices. An attempt has been made to reduce the number of these requests by defining specific data items that could be requested by program directors, in the form of a Contractor Data Requirements List. The Air Force Logistics Command's two-volume manual 310-1 (on data management) has been revised in accordance with recommendations from an Air Force/Industry Data Management Symposium. The general aim of the changes is to impose more control over data management practices and to emphasize those practices which will lead to a reduction of the quantity of data which the contractor must deliver and the Air Force must keep track of. Although many data are provided to the SPO, a large amount of it requires approval and consent of the Air Force. Considerable discussion ensues as to whether approval of a particular document submitted by the contractor constitutes contractual action and revokes any prior contractor/Air Force commitment. Total package procurement suggests that data submittals be relegated to visibility items only. The SPO is inadequately staffed to respond to the many data items requiring SPO approval in accordance with specified schedules, and many submittals therefore receive only cursory attention (if any) to relieve the SPO from its commitment to provide written

approval of documentation requirements to the contractor. One SPO interviewed said "You can't expect us to read each of these documents and provide the necessary coordinated approval in the time-frame specified; and besides, we depend on the contractor to go through it." Nevertheless, Contractor Data Requirements Lists continue to proliferate the requirement for a vast amount of government approval on documents which clearly lie within the realm of contractor responsibility under the concept of total package procurement.

Data requirements have been a major cost area of systems acquisitions, which have previously been hidden. They remain a major cost area because of the vast amount of data that must be submitted to the government without clear definition of its need. Although not yet implemented, the Air Force is attempting to develop a policy of "deferred" data delivery on all major programs, where feasible. In this technique, the prime contractor maintains a depository of engineering drawings and other data from which the Air Force can request individual pieces of data as needed for maintenance, repair, or other such purposes.⁶⁹

Disengagement

The introduction of more formal procedures and documentation tends to reduce the risk of wrong decisions, but to increase the cost and time required to accomplish the job. Furthermore, it tends to

⁶⁹Harold D. Watkins, "Air Force Tightens Rein on Required Data," Aviation Week & Space Technology (October 18, 1965), 41.

discourage contractors from making innovations, puts more obstacles in the path of the man with an idea, and induces decision by committee in place of decision by command. Detailed management systems are in conflict with one of the main objectives of the total package concept: to establish a long-term program under competition, and then to disengage to the maximum practical degree.⁷⁰ This principle of maximum disengagement in total package procurement appears to be creating much confusion about what the government means by program visibility and disengagement from certain controls over industry.

General Davis, former Vice Commander of AFSC, agrees that the principle of disengagement is extremely acute under total package procurement, and states that "The military cannot completely abrogate its responsibility, and if the system ordered did not meet the established requirements, it could have grave impact on the national security."⁷¹ General Davis further states that "The keystone of a management system of total package procurement is the ability to step in if needed, instead of day-to-day participation in the detailed management. Disengagement does not mean that the military or government agency gives up control, but rather there will be close monitoring and the government will step in when it has to and retain the right of control to achieve military requirements and objectives."⁷²

⁷⁰ Col. Robert E. Lee, "Total Package Procurement Concept," Defense Industry Bulletin (August, 1966), p. 12

⁷¹ Lt. Gen. W. A. Davis, "Management Systems for Package Procurement," Defense Industry Bulletin (December, 1966), p.2.

⁷² Ibid.

A specific objective of the AFSC Management System Control Board is to address the question of disengagement and visibility. It appears that this will be a never-ending task, and in the meantime, significant controls will be placed upon the contractor until the principles of disengagement have been well exercised.

Financial Reporting. One of the most recent controls placed on the contractor has been a Cost/Schedule Planning and Control Specification System (CSPCSS). It is basically a financial management reporting system which the government expects a contractor to build from his own financial management system, and is considered flexible enough to be used on all programs. The important benefits of this approach, as outlined by General Davis, are:

1. Individual contractors will receive only one kind of demand for financial management information from system program directors whether or not TPPC is applied.
2. The use of the same data by both contractor and the system program director in the management of the program will greatly improve accuracy and reliability.
3. A valid base is established for effective response to management information requirements of headquarters USAF and DoD with minimum impact on contractor operations.⁷³

This detailed financial management reporting requirement has been severely criticized by major weapon system contractors, who claim increased Defense Department control over their technical and financial

⁷³ Ibid., p. 3.

performance. At a National Security Industrial Association procurement symposium, D. E. Browne, Vice President of Finance at Lockheed, outlined the aerospace industry concerns over CSPCSS:⁷⁴

1. It will lead to loss of control by the contractor over his own organization (this is based on the fear that once the Defense Department obtains detailed information on project status, it may be used with this result).
2. Industry will be required to divulge insider information (the Securities and Exchange Commission has rigid regulations against this).
3. Requirements will be imposed on industry for useless data.
4. Industry will lose freedom to constantly improve technology particularly vital in the aerospace field.
5. Burgeoning government management staffs will become partners in management instead of performing surveillance.

Leonard Marks, Assistant Air Force Secretary for Financial Management, pointed out at the same symposium the importance of such a system, telling the industry audience:

In the past couple of years we have experienced too many surprises in the form of requests for substantial funds not anticipated at the beginning of the year to have confidence that the contractor either knows where he is going or has leveled with us about the status of the program. We must assure ourselves that the contractor has a good internal control system and that he uses it in the management of a

⁷⁴D. E. Browne, cited by Katherine Johnsen, "USAF Hits Industry Attitude on Tighter Contract Control," Aviation Week & Space Technology (October 9, 1967), 114.

particular product. And finally, that he is providing us in a timely fashion, valid summary data drawn from this contractor management system.⁷⁵

Major General G. F. Keeling, Air Force Assistant Deputy Chief of Staff, said:

The Defense Department has neither the moral nor the legal right to disengage itself from contractor performance--the government is banking this game and we must make sure that it is honest--we must make sure that we receive equipment on time at the agreed price, that performs as advertised and unfortunately too often it does not. If you are not doing the job, are we not entitled to know about it? We are not playing children's games.⁷⁶

These comments show that the Air Force professes a need for "visibility" rather than control and at the same time talks about disengagement. Secretary Marks protests that the industry has referred to disengagement as complete abdication of government control. He indicates three main reasons why CSPCSS is required to keep the Air Force informed regarding current project status:⁷⁷

1. There are major changes to a system during development and the cost of these changes is negotiated well after the fact, with the implications of the change unknown to the Air Force.
2. Because of tightly funded weapon systems, the scope or pace of the project must subsequently be changed to reflect the available financial resources.

⁷⁵Leonard Marks, cited by Katherine Johnsen, "USAF Hits Industry Attitude on Tighter Contract Control," Aviation Week & Space Technology (October 9, 1967), 114.

⁷⁶Maj. Gen. Gerald F. Keeling, cited by Katherine Johnsen, "USAF Hits Industry Attitude on Tighter Contract Control," Aviation Week & Space Technology (October 9, 1967), 114.

⁷⁷Leonard Marks, cited by Katherine Johnsen, "USAF Hits Industry Attitude on Tighter Contract Control," Aviation Week & Space Technology (October 9, 1967), 114.

3. The majority of defense contracts are non-competitive in spite of fixed price contracting.

General Davis explains that CSPCSS is so flexible that a specific financial management system designed exclusively for total package procurement has not been required, and he indicates that the specification is a contractual requirement on the C-5A and the SRAM programs.⁷⁸ While CSPCSS may be mechanically adaptable to total package procurements, its rationale for application, as presented by Secretary Marks, is the reverse of the philosophy upon which total package procurements should be awarded. Basic tenets of the TPPC are a fixed price contract for a well defined, well thought through program, with special clauses discouraging changes.

Proponents of CSPCSS cite its TPPC application, but in fact, it was not part of the negotiated C-5A contractual requirements. Discussions on the use of CSPCSS subsequent to the C-5A award resulted in Lockheed consenting to use the financial management control system on a trial basis on a segment of the program. This six-month trial was concluded in February of 1968, almost two years after the contract award. The system is still not considered a total program contractual requirement by Lockheed.

⁷⁸Lt. Gen. W. A. Davis, "Management Systems for Package Procurement," Defense Industry Bulletin, (December, 1966) p. 3

The SRAM RFP included the CSPCSS reporting requirements. The contractor has instituted the system for all work packages for financial management reporting. A computer system is tied in by hard line to the SPO so that on-line, real-time information can be retrieved by the system program director at will. The contractor claims compliance to the specification requirements in providing the financial reporting to the government, but indicates that it is not expected to be a real picture of the situation because there are still many bugs in the system. Generally, internal management assessment is required to obtain the actual cost/performance picture of the program. The contractor further indicates that the work breakdown structure is not definite at the time of contract definition. Work packages continually change throughout the development period, causing distortions of the financial management reporting due to time lags and redefinition of the work packages.

The Mark 17 program did not include a contractual requirement for CSPCSS, but its implementation was discussed with the SPO. Avco might have instituted this system had the program not been terminated. Avco will attempt to incorporate the specification on other in-house programs.

It appears that while contractors indicate that such a system could be incorporated only at increased cost because of the level of detail

required, government agencies insist that it does not necessarily result in additional cost and is simply a reformatting of reporting requirements from internal financial management systems. While several interviewees indicated some relaxation of controls, financial management control has been increased. One Air Force SPO said, "The government is going way overboard in financial control under the guise of visibility and...the CSPCSS will unfortunately be a thorn in the contractor's side." An additional problem cited by contractors was that CSPCSS will stifle the correction-of-deficiency clauses and the contractor's desire to assume greater risks. One contractor interviewed stated:

In spite of altruistic statements to the contrary, it is difficult or impossible to ask a contractor to risk considerable profit gain or loss on program management ability on one hand and at the same time ask him to expose his detailed status and plans on the other. People being people, such information will always be used in negotiations or technical direction to the detriment of the contractor.

Another contractor program director remarked, "It created significant waste of technical people, animosity, and conflict,...technical performance being overshadowed by detailed cost control requirements."

In principle, it appears that the CSPCSS is desirable. However, details of implementation are not only difficult to apply, especially to development programs, but more importantly, are in conflict with the criteria of the TPPC.

One of the reasons given for the move toward greater government authority in dealing with contractor cost data submission emerges from the belief in both Congress and the Defense Department that the Truth in Negotiations Act (Public Law 87-653) has not been followed by appropriate Armed Services Procurement Regulations (ASPRs) to enforce its intent. Aviation Week quotes one Defense Department source on the misgivings over the move toward close supervision of contractor cost data:

Congress seems to be expressing increasing lack of trust in the Defense Department and in industry. It's not certain that increased fishing privileges for the Pentagon into company records would be the best thing that could happen in Defense Department/contractor relations. It's just too much fun to have these privileges and they could raise hell with fixed price contracts.⁷⁹

Several remarks by B. D. Haber of North American Aviation during the Air Force/AIA Aerospace Technical Council panel discussion on management systems in April, 1967 are summarized here:

In preparing requirements for systems management intended to cover a wide variety of cases there is a tendency to write a basic specification intended to cover the project having maximum size and complications but with minimum urgency or need for economy. The theory is that when other types of projects of less complexity which are not needed for economy are initiated, the contractor should request deviation from the basic specification. In actual practice, this procedure frequently falls down seriously, particularly when there is a competitive atmosphere. Under these conditions either the contractor is hesitant to request deviation, which may or may not be granted, or personnel in the project office hesitate to grant such requests which seem to run counter to the intent of the basic specification.

⁷⁹Donald C. Winston, "Cost Disclosure Showdown Nears," Aviation Week & Space Technology (October 2, 1967), 16.

We suggest that to avoid waste and under-management, the Air Force should be very careful to stipulate only the result desired and avoid stipulating the specific procedures which the contractor must follow. Where there are a number of contractor organizations working together on a given project there must of course be certain cooperation and standardization of data to assure good communication.

At policy level, the Air Force has shown great understanding of the problem previously discussed. It often happens, however, that at the first level of contact in the Air Force, there is somewhat less breadth of understanding of these policies and a distinct unwillingness to accept a risk in their interpretation. It will be helpful if there can be established within the Air Force efficient coordination and followup to ensure that broad policy with regard to systems management be interpreted with equal broadness at the working level.⁸⁰

Systems Management. While most of the discussions on systems management control have been restricted to the financial aspects, another important feature with regard to disengagement is also shrouded in controversy. Secretary Charles, in citing the responsibility given to a contractor under the total package concept, says, "The contractor must be left alone to his own devices in carrying out that responsibility subject only to the government's overriding national defense responsibility if it appears that he cannot do the job."⁸¹ This position implies disengagement of considerable magnitude. It suggests that the government should get into the contractor's activities only when the situation appears to be moving out of control, and not as a continuing process in the design of an otherwise promising system. Lieutenant General

⁸⁰B. D. Haber, Industry Remarks During Air Force/Aerospace Technical Council Panel Discussion on Management Systems, Aerospace Industries Association of America, Inc. April 4, 1967 (remarks prepared by K. Perkins of McDonnell and presented by Haber of NAA).

⁸¹Robert H. Charles, "Remarks by Robert H. Charles" (Institute of Government Contracts, sponsored by the Southwestern Legal Foundation, September 30, 1966), p. 13.

Charles H. Terhune, Jr., Vice Commander of the Air Force Systems Command, who is responsible for Air Force/Contractor management systems, has pointed out that disengagement to the extent indicated by Secretary Charles is practical only when the Air Force can explicitly describe the minimum acceptable performance of the system.⁸² This type of disengagement would, in a sense, drop many of the contract officer or plant representative approval requirements, and would eliminate item-by-item approval of subcontractor and preliminary and final design reviews. General Terhune is quick to point out that:

...disengagement does not mean divorce or separation of the Air Force from the contractor without "visiting rights." We must maintain a degree of visibility into the contractor's work to monitor the progress of the program, to be on the scene in the event changes are required in the contract, and to ensure that public funds are being spent wisely. Our goal is balance between over-control and a complete hands-off attitude. The visibility we seek is intended to fall considerably short of detailed management, microscopic review, or pinpoint control. Disengagement is possible and visibility of this type is feasible when we can write contracts that are truly definitive.⁸³

Many studies on disengagement report the beneficial effects of minimum surveillance. One of the earliest studies was conducted by Stanford Research Institute based on experience on a particular development contract, and suggested many advantages of minimum government intervention.⁸⁴ A later study, conducted by one of the Air Force non-profit organizations (TRW Systems), concludes:⁸⁵

⁸²Lt. Gen. Charles H. Terhune, Jr., "Management Progressiveness" (remarks at AF Association Fall Meeting, Washington, D.C., September 13, 1967).

⁸³Ibid.

⁸⁴The Industry-Government Aerospace Relationship--An Experiment in Disengagement. Stanford Research Institute, Menlo Park, California (May, 1963).

⁸⁵Kenneth H. Borchers, On-Condition Program Control--A Discussion of the Concept of Program Control in the Disengagement Policy of Secretary Charles, TRW Systems, Document No. 99900-W167-RO, (November 1, 1966), p. 5.

1. For the government to relax controls in day-to-day activities, it must be given increased program visibility to determine when intervention is necessary on critical problems.
2. Government and industry, in particular, should take immediate action to develop tools necessary to provide the program management with the visibility required for a successful change from a planned to an unplanned control philosophy.

Secretary Charles, recognizing that detailed government management of a program is wholly incompatible with total package contracting (and even perhaps fixed price or incentive contracting), established a DIAC subcommittee to investigate the authority/responsibility relationship inherent in total package contracting, and the question of whether the TPPC presents problems unique and substantially different from those inherent in any firm price contractual environment. The subgroup's major conclusions, as yet unpublished but presented at a DIAC meeting, are as follows:

1. Contractor latitude much greater under TPP than under fixed price "development-only" environment.

Performance/cost trade-off decisions not limited to merely optimizing result during development, but must optimize result insofar as operational article is concerned. Contractor's interests became more aligned with those of Government in TPP. Hence, less control needed.

2. The Government must discipline itself in management of TPP.

Critically appraise "review and approval" requirements. Eliminate or modify where possible. Clearly

delineate "milestone" reviews. Limit action generally to advising contractor of apparent or potential non-compliance. Contractor must be given authority to make trade-off decisions consistent with his responsibility for end result.

3. The Government must exercise control over informal direction, e.g., engineer to engineer.
4. The Government needs to have clear, accurate and current knowledge of contract status and contractor progress.

Visibility and right to intervene when clearly necessary.

5. No need for new procedural guidance at this time.⁸⁶

While most studies on disengagement conclude that it must occur in total package contracts, they add that it is not occurring to the extent necessary to be consistent with the premises of contractor total responsibility. It appears that the major resistance to such disengagement is coming from government laboratories and non-profit organizations that provide technical direction. Contractor interviewees reacted most violently while commenting on the role of the SETDs. They felt that SETDs are unwilling to discipline themselves so as not to intervene unnecessarily in the prime contractor's day-to-day efforts to meet the rigorous commitments for which he has contracted. This complaint seemed to be particularly directed toward technical personnel under the SPO, and was especially acute in the Mark 17 program. The Mark 17 had two SETD organizations--one for the development of the Mark 17

⁸⁶G. C. Bannerman, Report to DIAC on Working Group Studying TPP versus Controls, October 13, 1967 (unpublished).

and one for the integration of the Mark 17 into the Minuteman Weapon System. Many technical resolutions were subject to approval-cycle iterations to ensure that both SETDs concurred.

One contractor indicated reluctance to accept requests for additional studies, tests, etc., which did not appear mandatory to the success of the program. The same contractor indicated that the SPO was reluctant to provide formal technical direction to implement the frequently varying and conflicting technical requirements, since to do so would have compromised the "total contractor responsibility" which was supposed to be defined in rigid performance specifications at the outset of development. Accordingly, technical direction tended to be imposed by coercion, unofficial letters, telegrams containing advice, "delaying tactics," telephone suggestions, and informal meetings. Contractor requests for contractual coverage were frequently ignored, presumably in the hope that the contractor would eventually do the work to keep the program moving. Additional comments on the role of the SETD were that depth was intensive, demanding and overly detailed in areas where expertise was available, but skimpy and shallow in other areas.

Another contractor indicated that the SPO exercised restraint to the point of injuring the program. When it was required to make decisions on particularly sensitive systems engineering problems it was not there, resulting in an unglued system, recognized too late by the government and causing many program changes and excessive cost

due to restudy and redesign. Most contractors indicated that the extent of disengagement was not clearly understood nor specified; in fact, many of the contractual regulations indicated engagement to a degree inconsistent with the total package award. One SPO went as far as saying that SETD should be eliminated on total package procurement acquisitions.

While Air Force officials have proclaimed the policy of disengagement along with total package awards, several inconsistencies are apparent. The total package awards have not been defined to the point where disengagement can be practiced. In addition, the amount of visibility required to permit disengagement actually results in increased controls and information requirements on the part of the contractor which stifle his technical progress and add to the cost of the system.

The Navy has employed total package procurement in the award of its Fast Deployment Logistic (FDL) ship, yet many officials are generally opposed to the concept on the grounds that they are reluctant to abandon a major share of control over a program to the prime contractor. In the process of awarding the FDL contract, the Navy lost two admirals, who resigned in protest over employment of the procedure.⁸⁷

⁸⁷"Controversial Total Package Plan Tested," Aviation Week & Space Technology (Mid-December, 1967), 25.

It appears from interviewee discussions that the government laboratories and non-profits can be better used by concentrating on systems engineering and definition of program performance requirements prior to the award of a total package development/production contract. Unless the system performance criteria are well defined at the conclusion of contract definition, it becomes virtually impossible for the SETDs to keep from becoming partners when program changes become the way of life during development. This negates the advantages of total package procurement and the associated disengagement philosophy. There appears to be a desire for a considerable change in emphasis in the role of the SETD, to apply its resources to a great extent during the concept formulation and contract definition phases rather than during the development and production phases. This does not seem to have happened in at least two of the cases studied; in fact, the resources applied during the acquisition phases were much greater than in the formative and definition phases. It is here that government technical know-how must be preserved so that the government knows what it is talking about when it makes a decision to proceed along a given technical path.⁸⁸

One of the reasons why incentives may not be working can be attributed to SETD interference in the day-to-day design decision

⁸⁸ Robert H. Charles, "Remarks by Robert H. Charles," (Institute on Government Contracts, sponsored by the Southwestern Legal Foundation, September 30, 1966), p. 2.

making. A contractor's failure to achieve its objectives, hence the incentive rewards, could be charged to the interference.

Funding

Contractor funding is not a major problem in total package procurement, but nevertheless is an area where present practices and controls are in basic conflict with the total package concept. Congressional appropriations require a breakout of RDT&E funds separately from production funds to determine fiscal year production buy requirements. The contractor does not spend his money this way. If the total package contractor encounters technical difficulties during RDT&E, requiring additional dollars, he will reallocate his funds to overcome the development problem as soon as possible. This shift is required to meet a firm production commitment or a firm production design with enough lead time or to avoid massive retrofits that might be required if the design changes affect items in production. Boeing's Vice President of Contracts, Howard Neffner, points out:

This tends to start a reaction cycle; the contractor's control system begins to predict an overrun and the government begins to criticize the contractor's management and talk threateningly of escalating its position from visibility to surveillance to control and possibly to intervention. Meanwhile, both contracting organizations begin to struggle with chronic funding problems.⁸⁹

The problem is further complicated by the Bureau of the Budget, which insists on spoon feeding the funds to OSD. At present, this

⁸⁹Howard W. Neffner, "New Methods of Large Systems Procurement," (address delivered at the NSIA Procurement Symposium, Washington, D.C., September 28, 1967).

funding is averaging three to four times a year on the R&D portions of the contract. At certain times during the development phases, a contractor may find himself in an underfunded condition while stringent government regulations hold him liable for costs not funded by the government in the event of termination. Both the government and contractor interviewees disagree with this policy and would welcome a fully funded situation, particularly under the total package procurement concept. The present funding regulations have not been affected by the one-price-for-development-and-production policy of the TPPC.

It was pointed out earlier that the initial target cost of total package procurement did not reflect what the Air Force or contractors confidently expected to achieve, and that the actual target cost generally ate away at the contractor's fee. DoD continues to budget and fund to the published target cost data, even though they expect the final cost to be higher. Moreover, they have a commitment to the contractor to pay as high as the ceiling but refuse to recognize this in their budgeting process, resulting in a persistent lack of money at service headquarters. Sometimes this leads to cancellation, curtailment and postponement of critical programs and at other times to the fielding of operational systems lacking performance criteria consistent with the current threat. New fiscal year funding is then counted on to provide the necessary retrofit performance capability changes, rather than waiting for or petitioning for additional funds to change the basic system.

Change Activity

The total package concept itself should limit the amount of changes introduced after contract award, since it attempts to provide better contract definition in which performance details are spelled out rather than design details. The negotiation of a total package contract before the final contractor has been selected has provided an additional limitation on changes. Limitations on the contractor's profits for changes made at his instigation beyond certain thresholds may find the contractor facing penalties rather than reaping profits under changes. Permissible changes to the total package contract are restricted primarily to those necessary for flight safety or those required to make the system work. While total package proponents insist that worthwhile changes not covered by the incentive provisions will be made, it appears that the SPO is extremely hesitant to allow changes for fear that the contractor will use them to "get well."

To discourage changes on both the C-5A and SRAM programs, only changes of \$100,000 or more in target cost are allowed. This floor on change activity does not seem to have been a significant deterrent to the execution of either program. On the SRAM program, changes were government directed and led to a significant increase over the initial target cost. Authorized increases in C-5A target cost are close to \$4 million--a negligible increase compared to the SRAM and Mark 17 increases. Lockheed estimates that the plus and minus changes falling within the \$100,000 floor have balanced each other. Lockheed's change clauses with its subcontractors are much more

protective than its government clauses, with compensation limited to such items as raw materials, tooling, parts, and equipment, but not for increased costs of labor (economic escalation clause).⁹⁰

The SRAM and Mark 17 changes were not in the "gold plating" category (proposed in an attempt to increase the volume of the contract), but were performance and interface changes necessary to define the system. Contractors and SPOs generally agreed that changes are necessary and result from technology advances and redefinition of performance criteria to meet the mission specified in the RFP.

Organizational Behavior

Interviewees did not indicate any particular organizational structure or behavior dictated by the total package contract; rather, their organizational behavior was more significantly influenced by competitive fixed price contracts. Government agencies indicated that whether the contractor was organized along functional, matrix, or project lines meant little to the performance of the contract as long as the organizational structure was understood by the SPO. The only significant trend noticed among the senior contractor personnel was an increased awareness of the cost picture of the program. This increased cost awareness seemed to permeate down to each task manager, to the point where cost accounting, scheduling, and control created sufficient activity to

⁹⁰Harold D. Watkins, "Air Force Tightens Rein on Required Data," Aviation Week & Space Technology (October 18, 1965), 45.

demand a major amount of his time in the execution of design responsibilities. This attitude perhaps lends additional credence to the conclusion of one report which indicates that sole-source contracts produce higher levels of technical performance.⁹¹

Innovation and Quality

Along with disengagement, technical innovation and product quality has been one of the major concerns of procurement officials in using the total package procurement concept. Aware that technical innovation is more important than the method of procurement, both the Department of Defense and the Air Force have initiated several studies addressing the question, "Does total package procurement stifle innovation and creative technology?" In response to an Air Force request for a specific analysis, RAND Corporation reported the following conclusions:⁹²

1. Total package procurement has the effect of making the results of the CDP more binding and of reducing the potential for program improvement subsequent to contract award.
2. If the creative activities of government technical personnel during the acquisition phase have led to increased quality of the product, then total package procurement, which should result in a shift of these talents to the definition phase, will degrade the quality.

⁹¹ Irwin M. Rubin, Project Management and the Role of the Project Manager (working paper, Research Program on the Management of Science and Technology, Alfred P. Sloan School of Management, October 1966), p. 8.

⁹² Thomas K. Glennan, Jr., Innovation and Product Quality Under the Total Package Procurement Concept, The RAND Corporation (September, 1966), pp. 25-26.

3. If the desire for objectivity of evaluations in the contract definition phase results in slighting subjective judgments of source selection, then inhibition of technology or erosion of quality may occur.
4. Decisions on changes should be made without regard to artificial contractual constraints. If they result in improvements of technology, they should be made at the expense of allowing the contractor to improve his cost position.
5. TPP is most likely to have serious adverse effects on innovation and quality in systems developments in which the requirement is uncertain, the need is extremely urgent, the technology is unproven, or the measures of system effectiveness are diffuse and qualitative.

To ensure a proper definition of technical innovation and product quality, the RAND report defines innovation as "the incorporation of improvements in a design made possible by experimentation or analysis," and defines quality as the "absolute level of usefulness or capability in a design."⁹³

Secretary Charles disagreed with the basic conclusions of the RAND report, and felt that it was a study of inadequate depth that may not stand the test of time.⁹⁴ According to Charles, the ultimate determination of innovation inhibition will be made when the Air Force can compare its expectations with the contractor's promises. Nevertheless, the subject was

⁹³Ibid., p. 12.

⁹⁴Personal communication, February 28, 1968.

of sufficient concern to convene a DIAC subcommittee which addressed the question of inhibition of technical innovation. Among its conclusions were the following:

On balance, within-contract-scope-type innovations are not retarded by TPP but...beyond contractor scope performance improvements are discouraged by TPP. Many forces such as desire for new business and the designers natural inclination to improve the product, operate in addition to the contract itself. Thus, some beyond-contract-scope innovation may take place, but less than what would occur on development-only contracts. The above conclusions must be taken in context with the subgroup recognition that TPP is one of many factors (such as contract definition, fixed price contracting, etc.) that push in the direction of achieving no more than contract requirements, and that the subgroup was unable to positively separate the effects of these factors.⁹⁵

The Logistics Management Institute (LMI), a working member of the DIAC subgroup, also published some preliminary results which do not completely concur with the official conclusions quoted above. LMI indicated that the working group considered innovations of two kinds--engineering development, which includes "inventions or developments in unique components and assemblies which are deliberate attempts to achieve the stated technical requirements of the system under contract," and growth innovations, which are concerned with "engineering or scientific improvements aimed at improving on system performance capabilities beyond the stated requirements."⁹⁶ LMI reported that the majority of seventy-five designers and engineers interviewed indicated that TPPC would not inhibit technical

⁹⁵Quoted from the minutes of the October 13, 1967 DIAC Meeting at the Pentagon, Washington, D.C.

⁹⁶Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June, 1967, p. 22.

innovation. However, LMI also indicated that in several instances technical innovation had been inhibited because of the emphasis on cost and schedule associated with the total package concept (or perhaps the fixed price aspects).⁹⁷ LMI interviewees also stated that management instituted discipline by limiting the amount of money available for study and investigation of alternative approaches and derivative projects. Those expressing this opinion were quick to point out that TPPC-developed systems will be less sophisticated than what could be designed but will be what the customer pays for.⁹⁸

The Defense Science Board, appreciably concerned about the inhibiting technological growth factor in new contractual procurements, has created a committee to determine whether incentive contracts, on the whole, stifle technical innovation.⁹⁹ Secretary Charles' view on technological inhibition is that if it exists it can be controlled by 1) expressing contractual requirements in terms of performance, thereby leaving the contractor free to achieve those requirements in his own way, without government approval, and 2) providing bonuses for exceeding contractual performance.¹⁰⁰ He believes there will be fewer changes under the total package procurement concept than under the old system, but changes improving the product will

⁹⁷ Ibid., p. 23.

⁹⁸ Ibid., p. 25.

⁹⁹ "Controversial Total Package Plan Tested," Aviation Week & Space Technology (Mid-December, 1967), 24-27.

¹⁰⁰ Robert H. Charles, "Remarks by Robert H. Charles," (Institute on Government Contracts sponsored by the Southwestern Legal Foundation, September 30, 1966), p. 12.

be just as frequent as they ever were. General Davis, on the other hand, states:

There is a tendency to freeze technology at the current state of the art.... [In] such a situation, downstream we get essentially what was bought years earlier probably incorporating very few, if any, significant technological advances achieved after the original contract was signed. The contractor is not motivated to include or aggressively pursue technological innovations that would improve the system if such an improvement would result in increased cost. The fact remains that technological innovation which might greatly enhance the value of a given system beyond its original specifications, is inhibited to some extent.¹⁰¹

Policy makers of the total package concept indicate that rewards appropriately defined by incentives will provide a contractor with maximum latitude and great motivation for the application of creative effort, thus fostering innovation.¹⁰² Most of the interviewees indicated 1) that they were having their hands full getting the required performance; 2) that the present incentive structure would not cause them to make any commitments beyond the performance requirements; 3) that competition forced the contractors into optimistic performance specifications; 4) that the contractor was highly unlikely to make changes except to satisfy the minimum requirements; 5) that contractors were reticent to propose anything above minimum unless they were going to get paid for it; and 6) that the Air Force was not receptive to changes that cost money. One contractor attempted to use technical shortcuts to meet the initial target cost, which in the long run cost more rework and more money than would initially have been expended

¹⁰¹Lt. Gen. W. A. Davis, "Management Systems for Package Procurement," Defense Industry Bulletin (December, 1966), 2.

¹⁰²Robert H. Charles, Total Package Procurement Concept (February 18, 1966), p. 7.

without the shortcuts. While admitting to poor management, the target cost and ceiling were influential in making tight technical corners.

Whether or not technological innovation has been inhibited by the total package concept remains a somewhat controversial question, as can be seen by the above comments. It is further complicated by the inseparability of incentives, competition, fixed prices, and total package contracting. Nevertheless, if innovation refers to things new to the firm, not necessarily new to the world, then the pinch of competitive promises of performance and fixed price incentive contracting, with firm commitments to production, appears to be stagnating the imaginative resources of the designers and engineers. On many of the contracts studied, a large number of seemingly minor improvements resulted in aggregate synergistic effects and can be considered innovations of significant consequence by some definitions.

A study on industrial innovation¹⁰³ indicates that the major contributor to the process of technological innovations is "...an army of technical employees whose daily job is gradually to improve the technology of the firms they work for. Their attitude toward innovation and how they behave about innovation are of fundamental importance to the rate and quality of innovation. The sum total of these attitudes determines the propensity of the firm to innovate."¹⁰⁴ Such attitudes in firms engaged in defense research and development would tend to produce the type of weapon systems that gave

¹⁰³Sumner Meyers, "Industrial Innovations and the Utilization of Research Output," Proceedings of the 20th National Conference on the Administration of Research, 4th Session, Denver Research Institute, 1967, p. 138.

¹⁰⁴Ibid.

the United States the strategic superiority that it once enjoyed. The present procurement processes, whether they be incentive and/or fixed price, seem to be compromising the propensity of a firm to innovate. Clauses accompanying total package contracts, designed to discourage contract changes, are producing a new breed of engineer who sounds and thinks more like a lawyer than an engineer.

One of the minor conclusions reached in the RAND report was that the government should consider allocating more funds to research and exploratory development to balance the shortcomings of technological innovation in total package procurements.¹⁰⁵

Project Hindsight, investigating the role played by research in the development of weapon systems between the end of World War II and about 1962, showed that if the Department of Defense had merely waited passively for the non-defense sectors of the economy or government to produce the science and technology needed, the nation's military equipment would be far inferior to what it is today.¹⁰⁶ This study also pointed out that one-third of all innovations occurred during the operational systems development.¹⁰⁷ Research and development expenditures as a percentage of total defense expenditures has continued to decline since 1962.¹⁰⁸ The expenditure

¹⁰⁵ Thomas K. Glennan, Jr., op. cit., pp. 23-24.

¹⁰⁶ Chalmers W. Sherwin and Raymond S. Isenson, "Project Hindsight," Science (June 23, 1963), 1576.

¹⁰⁷ Ibid., p. 1574.

¹⁰⁸ "Defense Financial Summary," Aviation Week & Space Technology (January 30, 1967), 26.

required by hostilities in Southeast Asia has diverted more defense money. This drain on research and development is bound to stagnate the inventiveness of R&D organizations, and only government has the power to rescue technical organizations from a fatal decline and to put new life into them.¹⁰⁹

With total package procurements designed to limit technology development to the basic requirements of the particular weapon system, increased emphasis must be placed upon exploratory and advanced development programs which will lead to a strategic weapons superiority which, in the last eight years, has gone from a 4-to-1 advantage to a standoff.¹¹⁰

Total Responsibility

One feature necessary for the success of a total package procurement is a model contract which specifies the total system performance requirements in terms of its overall mission rather than a design specification leading to a particular solution. Contractor responsibility for the total system is enforced through a correction-of-deficiency clause which binds him to the achievements of the performance guarantees specified in his proposal and subsequently adopted by the government in the model contract.

Under competition, it was found that contractors were prone to make extravagant performance estimates in addition to commitments which were not mandatory requirements of the RFP. This brochuremanship on the part of the contractor was aggravated during Phase C of negotiations by

¹⁰⁹Edward B. Roberts, "Life Cycles of R&D Organizations," Massachusetts Institute of Technology, Alfred P. Sloan School of Management [n.d.], p. 3.

¹¹⁰Personal communication from an industry member of the Defense Intelligence Advisory Board.

government pressures to increase performance achievements even at the risk of decreasing confidence. The government then accepted the estimated contractor performance commitments and placed them on contract as minimum guarantees, enforced with the correction-of-deficiency clause.

Correction of Deficiencies

Correction-of-deficiency clauses are not new and have been contained in ASPR regulations on procurements other than total package. One SPO interviewee said that the clause was to protect the Air Force from deficiencies in a system which they would be unable to detect by acceptance of the first article. However, in the past it has never created a significant problem with regard to contractor liability. It appears that the correction-of-deficiency clauses for total package procurements must be tailored specifically to the elements of performance contained in the contract, since the standard ASPR provisions do not appear to be enforceable and have not been in the past. Time works to the advantage of the contractor in that he can disclaim any deficiencies until the operational product has been delivered and an attempt is made to demonstrate and measure its performance requirements. The SRAM and C-5A contractors have been definitely motivated and guided in the performance of their work by the tailored correction-of-deficiency clause. This clause is the prime performance motivator, since the contractors have, in many cases, given up on performance incentives. The C-5A contract calls for a stronger-than-usual warranty. Air

Force acceptance at the time of delivery is not enough; Lockheed must correct any defects that show up in the six-month Air Force test period, and is responsible for structural defects for an even longer period of time.¹¹¹

While Air Force officials are anticipating the possible application of correction-of-deficiency clauses in two of the contracts studied, they are apprehensive about several loopholes which may prevent its effectiveness. It appears that government/contractor relationships can no longer operate in an atmosphere that avoids rigid inflexibility; rather, they must live to the letter of the contract. This is particularly true of the procurement personnel of the contractor/industry team.

Government Equipment

Prime contractor total responsibility runs into many difficulties if the contract stipulates government furnished equipment (GFE) or government furnished products (GFP). Both the government and contractors indicate that this presents an opportunity for the contractor to abrogate his total responsibility commitment, and in fact, can further lead to many changes in the conduct of the program.

Because Lockheed has overall responsibility on the C-5A program, including the government-supplied General Electric engines, they will participate in engine tests and must agree to accept the engine. After

¹¹¹"Pentagon Tests One-Stop Bidding," Business Week (November 6, 1965), 101.

acceptance, Lockheed has a contract with G.E. establishing responsibility for post-testing engine problems.¹¹² This unique Lockheed responsibility has led both the contractor and the Air Force to the conclusion that the supplying of GFE to a TPPC contractor is inconsistent with the basic total package precepts. An example of one problem it raises is that an airframe contractor experiencing trouble meeting its minimum performance guarantee, might feel that a slight compensating increase in engine performance will achieve the overall aircraft performance criteria. The Air Force is reluctant to direct this increase in engine performance because of its desire to minimize contractual changes and because of the problems of negotiating with a contractor in a sole-source environment. The government also recognizes that it can invoke the correction-of-deficiency clause with no change in the airframe contractor's target cost.

Government commitments to provide contractor-selected GFP have also led to many problems, diminishing the total responsibility of the contractor, particularly on the SRAM program. This was especially true when the government was required to provide certain test facilities on a predetermined schedule. Government inability to provide these facilities in accordance with their commitment has opened the door for many contract changes.

¹¹²Harold D. Watkins, "Air Force Tightens Rein on Required Data," Aviation Week & Space Technology (October 18, 1965), 44.

While it is the government's general policy to rely on the private enterprise system to supply its needs, it continues to get involved in direct procurement, even under the total package concept, declaring that in some cases it is in the national interest for the government to provide directly the products and services needed.¹¹³ SPO procurement officials interviewed said "It is folly to think that the government can supply a prime at the lowest prices."

Subsystem Impact

Total package concept proponents suggest that the total package will increase the likelihood that prime contractors will hold down their costs by competitive subcontractor bids for supplies and subcontracts. The majority of the interviewees indicated that this is not unique to total package procurement, and that prime contractors, when bidding competitively for a fixed-price contract, have done this in the past. Thus, no evidence exists that total package procurement has increased the intensity or efficiency of subcontractor negotiations. One Air Force procurement chief observed that prime contractors were more diligent in selecting subcontractors than the government was in selecting the prime contractor. There was some evidence, however, that the subcontractors were not given as many of the risk-alleviating provisions (especially economic escalation) in their contracts as the prime contractors had with the government.

¹¹³George C. Wilson, "New Rules Guide Government Contracting," Aviation Week & Space Technology (April 4, 1966), 26.

Although no subcontractors were interviewed, the prime contractors reported that the data submittals required of subcontractors were no more or less severe than those required of themselves, and that there were no special subcontractor complaints to the primes under total package procurements. Prime contractors were quick to point out that price competition for subcontracts was extremely severe, and that many of the subcontractors had more severe financial problems than the prime contractors. One subcontractor has threatened default unless financial relief is provided.

One question posed to the interviewees was whether total package subsystems requiring multi-technical, -management, and -interservice interfaces beyond the control of the prime contractors are adaptable to the TPPC. While interviewees conceded that this is theoretically possible, the main conclusion was that subsystem TPPC developments invariably fail to articulate the many interfaces during the CDP, and result in an award subject to multiple changes, thus mitigating against the use of total package procurement.

Logistic Support

In keeping with Secretary McNamara's second management principle--to provide weapon systems at the lowest possible cost--the Air Force directed its attention to the logistic cost as well as the production cost of hardware. Initially, Air Force regulations provided specific factors for

calculating logistic costs in evaluating production contracts.¹¹⁴ John M. Malloy, Deputy Assistant Secretary of Defense for Procurement, states that fifty procurements are in force or planned to test the philosophy of awarding production procurements based on life-cycle costing.¹¹⁵ Total package procurement introduced life-cycle cost considerations into development contracts. One of the major difficulties in defining life-cycle costs is the inability of contractors to predict accurately equipment reliability and maintainability. The most important logistic cost is corrective and preventive maintenance, which in many cases lies beyond the control of the supplying contractor.

In general, the types of logistic costs included in the programs studied were:

1. maintenance costs, which are the costs required to maintain the system during its operational life, including field maintenance, overhaul, repair at all levels, and the cost of government personnel performing such work;
2. training costs, which include the cost of training personnel to operate and maintain the system during its life; and
3. operating costs, which include the cost of operating the system during its life.

¹¹⁴William H. Gregory, "Air Force Weighs Ultimate Cost System," Aviation Week & Space Technology (June 22, 1964), 71.

¹¹⁵Philip J. Klass, "DoD Stressing Life Cycle Costing Plan," Aviation Week & Space Technology (January 16, 1967), 33.

The C-5A program attempted to define and firm up these costs at the outset of development. Lockheed is required to maintain the aircraft in service and must perform the entire maintenance until completion of Category II testing. Training equipment cost was included in the same manner as initial production quantities. Thus training equipment target prices were subject to the overall incentive formula, and to the furnishing of sufficient funds by the Air Force in time to manufacture and supply the equipment. This provision required that training equipment be specified in advanced of detailed design, and that the prices be established in competition.

Operating costs were very difficult to define for the C-5A because the maintenance and repair aspects were under the control of the government and could not be sufficiently defined to allow for an overall operating cost technique. Therefore, the productivity index, which was mentioned previously as a performance incentive, was substituted.

The Logistics Management Institute has conducted several studies related to the logistic costs of weapon systems. The most recent study related to total package procurement reported that life-cycle costing and the costing of logistic support equipment will have limited usefulness in total package procurement, and may limit the extent of contractor commitment under total package procurements.¹¹⁶ The C-5A interviewees stated that logistic costs were destined to be a major problem area. In particular,

¹¹⁶Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, June, 1967, pp. 68-69.

AGE, spares, and training equipment were priced with the most uncertainty and greatest contingency of the entire initial contract. The SRAM program, benefiting from the lessons learned on the C-5A, includes only pricing formulas in the contract, against which the government will order spares during the production period at the contractor's cost of producing the items. The Mark 17 program had no logistic cost commitment.

V. FUTURE TRENDS IN TOTAL PACKAGE PROCUREMENT

Most of the interviewees, when asked to comment on the future prospects of the total package procurement concept, indicated a general resistance to the entire concept and cited several specific complaints to illustrate their points. Both government and contractor interviewees were quick to point out, however, their willingness to accept the challenge of this procurement concept to obtain the benefits of increased discipline in their organizations, but claim that the TPPC was in many cases inappropriately and imprudently applied.

SPOs expressed the following concerns about the TPPC:

1. A guidance document is needed to define the disengagement envisioned. This is necessary to overcome the 34-year inertia built into the government/contractor relationship.
2. Determination must be made of the proper utilization of SETDs and government laboratories assigned for the development and production of TP weapon systems.
3. The procurement hierarchy should provide a field-level set of ASPR-type regulations in tune with the spirit of total package procurement, since execution and administration of these procurements have been by "osmosis."
4. Local AFPROs appear to be floundering in uncertainty as to what their assigned responsibility should be in executing total package contracts in a firm with a mix of various types of contracts. (Contractors

suggested that the government should conduct an in-depth case study of the so-called government monitoring or visibility process on a total package procurement, for only then will the required disengagement be determined.)

5. An investigation or at least a study should be made of the enforceability of a correction-of-deficiency clause tied to a total performance specification rather than details. This problem is particularly aggravated by the philosophy of disengagement, especially when it concerns qualitative mission performance success.
6. There must be much more contractor value to performance incentives, since there was no evidence that contractors were making any specific attempt to improve performance under the incentive provisions negotiated.
7. A higher confidence must be attained in the government commitment of GFP on total package contracts; otherwise, it must be completely removed.
8. AFLC must be more progressive to be an integral part of the total package procurement concept.
9. Change negotiations are taking too long. Contractors delay to avoid risk. Many SPOs indicated that changes in the firm production commitment could not be assessed for as long as 20 months because of an inability to define the nature of the performance requirements change in development.

10. Contractors are reluctant to take technical direction. SPOs feared for the achievement of a quality system and the performance specifications, since the contractor, under an impossible target cost, was carrying no backup system, using shortcuts, and embarking on a high-risk development program without any insurance. (Contractors replied that they were forced to comply with much artificial technical direction by threat, coercion and no funds.)

Based on these and other observations in Chapter IV, several SPOs expressed disenchantment with the total package concept, and preferred two separate contracts at the outset.

When SPO technical and procurement people were asked why they choose total package procurement for their particular weapon system acquisition, in light of their severe criticism, the majority responded that it was a result of the individual pressures and pursuits of DoD and Air Force senior-level procurement people. When the contractors were asked how they could justify their bidding on total package contracts in light of their claims of substantial risk and low return to the corporation, their answer was invariably that awards of major weapon system contracts are too infrequent; therefore, they must bid on whatever type of procurement the Department of Defense desires or go out of business.

Comment on the above reactions by DoD and Air Force headquarters personnel indicates that some of the criticism stems from a lack of communication

and understanding at the SPO level. Some think that the pendulum toward TPPC has swung too far, spurred by the SPO record-keeping function to increase the dollar amounts of incentive awards. While Secretary Charles will be less involved in future total package procurements than was necessary in the C-5A program, he feels that the field offices will be pushed toward total package procurements, or at least fixed price incentives. He cautions that neither the Air Force nor DoD wants contractors to experience catastrophic losses or crises.¹ He also states that perhaps many programs are not amenable to complete total packaging; however, partial total package procurements are acceptable providing that the segregatable part is well defined. Otherwise, partial total package procurement is not acceptable. For small developments (i.e., where the development cost is equal or less than 10 per cent of the total program), Secretary Charles feels that procurements may tend toward "fly-off" procurements, and that programs with development costs between 10 and 20 per cent may in fact be candidates for fly-off. He indicates that programs with substantial development and innovativeness should have two separate incentive contracts.

There appears to be a withdrawal of the early senior advocates of the total package concept, indicating that field officers might have been over-reactive in trying to comply with the desires of senior procurement people. Secretary Charles himself has new thoughts on some of the recent applications, and cautions and pleads with industry to become more flexible to cope with the

¹This and the following comments were part of a personal communication, February 28, 1968.

aggravations of international situations, technological breakthroughs, advances in the state of the art, and reduction of development funds to finance activities in Southeast Asia.² While USAF headquarters continues to emphasize total package procurement, there have been several warnings of caution against extending it without proper discretion. The former Assistant Secretary of the Navy, G. C. Bannerman, cautions that "total package must be limited to programs of very little technical risk, otherwise the government faces the risk that the contractors will be unable to make it."³ Mr. Neffner remarks, "There is a marked trend toward over-reaction in applying the concept.... It has been applied universally as the solution to the assumed shortcomings of the past.... The buyer not the seller has the ultimate risk of system performance.... The government must exercise restraint in the current trend toward over use and unless there is a complete total package with firm production commitment, change clauses or total system responsibility is inappropriate for total package."⁴

The Army, as its answer to persistent industry objections to contract definition, competitive follow-on procurement, and long-term commitment of resources on total package programs based solely on paper studies, is proposing that on selected procurements, fabrication and test of prototype hardware by two competing contractors be accomplished in the CD stage. They would limit

²Robert H. Charles (remarks at the DoD/NSIA Advanced Planning Briefings for Industry, Boston, Massachusetts, March 4, 1966).

³G. C. Bannerman, cited by Harold D. Watkins, "Air Force Tightens Rein on Required Data," Aviation Week & Space Technology (October 18, 1965), 44.

⁴Howard W. Neffner, "New Methods of Large Systems Procurement," (address delivered at NSIA Procurement Symposium, Washington, D.C., September 28, 1967).

application of this procedure to developments involving high production probability and relatively low development costs.

Considerable dispute remains as to whether the total package concept inhibits technological innovation. Although not proved conclusively, the threat of such a condition has given meaning to some of the changes proposed in future defense procurements. There are indications that innovation ends with the contract award, and that the contractors concentrate on schedule and price rather than performance. John Kenneth Galbraith, commenting on the bigness of industry, states:

Big business will undertake only such innovations as promise to enhance its profits and power or protect its market position -- free competitive men have always been the true innovators. Under the stern discipline of competition they must innovate to prosper and survive.... The characteristics of weaponry are uncertain and can lead to disaster. Technological compulsion... will require the firm to seek the help and protection of the state. The state must absorb risk and guarantee a market for the product and underwrite development costs.⁵

This philosophy appears to be taking hold in Air Force quarters. The Air Force Systems Command plans to strongly advocate development of prototype hardware concurrent with a system contract definition phase. In a recent article, General J. Ferguson, Chief of AFSC, is quoted as saying that the present procurement process tends to lessen the likelihood of new ideas in advanced technology being incorporated in the development of new

⁵John Kenneth Galbraith, The New Industrial State, pp. 20, 32.

weapon systems.⁶ General Ferguson's Deputy Chief of Staff for Development, General G. A. Kent, is quoted in the same article as saying:

Under the "CD with hardware" approach the Air Force would choose two or three contractors to build several prototypes and carry them through Category I testing on a CPFF basis or some other type of cost reimbursement basis with the government paying only for things authorized. Production would then be completed on an FPIF basis.⁷

The motivation behind this shift in development processes is the fact that the Air Force Systems Command wants engineers to devote their time to developing the best weapon system from strictly the technical and performance standpoint. They feel that this is not the case with the present procurement process.⁸

The Air Force expects that the increased cost of this type of procurement can be traded off against the visibility that it needs, to know what a system really can do before it is committed to production. This approach seems to be quite consistent with the Army approach, and may be the philosophy used in selective small development programs of the future. Ironically, the procurement cycle will have made a complete circuit back to CPFF "fly-off" contracting for development -- a government procurement concept of many years ago.

Rapid changes in procurement philosophy make any meaningful analysis of the eventual outcome of a particular procurement process subject to severe criticism for lack of a broad enough and long enough constancy to warrant valid conclusions. This rapid evolution of procurement methods makes any meaningful analysis somewhat subjective.

⁶Gen. J. Ferguson, cited by Walter Andrews, "Headquarter Command will Advocate Major Shifts in Development Process," Aerospace Technology (March 25, 1968), 32.

⁷Gen. G. A. Kent, cited by Walter Andrews, ibid., p. 34.

⁸Ibid., p. 35.

VI. CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented in this report are field experiences of contractors and government on three total package programs, the literature on the subject, and to a lesser extent, the writer's ten years of experience in the aerospace industry. It is difficult to generalize about the effects of the TPPC on weapon system procurement, and even more difficult to separate the effects of contract definition, fixed prices, and incentives from the effects of the total package concept itself.

Some may declare a sample of three contracts to be too small, and observations reached at such an early stage too premature. However, very few weapon system contracts have been or will be awarded under the total package concept, and evaluation cannot wait five to ten years for their completion. Therefore, an evaluation based on the total best available sample at a reasonable point in the development period can probably provide the most constructive guide to near-future defense procurements.

CONCLUSIONS

The danger of generalization becomes clear when one considers that many of the conclusions based on C-5A experience are not applicable to the SRAM and Mark 17 programs. The following conclusions are drawn from a consideration of all three programs, and relate to the seven principal benefits of the TPPC, as anticipated by the Air Force and described in Chapter II.

1. With the exception of a firm production requirement in the RFP, there was no indication that the contractor work statement was better defined (in terms of system requirements) before substantial resources were allocated to its implementation. In some cases, the development RFP was on the shelf for several years before it was issued, remaining essentially unchanged in terms of overall performance requirement oriented to a specific mission.
2. Optimistic performance promises and underestimates of target costs continue to prevail. These practices, inhibited to some extent by the contractor commitment to production, appear to have been encouraged during the competitive Phase C negotiations. Extravagant performance promises left no room for incentive profits and diluted initial target fees to achieve the requirements. The practice of "buying-in" was
 - a. encouraged by diffuse RFP performance requirements subject to change,
 - b. used by contractors to gain or regain a share of the defense market at the risk of short-term profit, and
 - c. practiced to lock out competition for future similar systems or for possible commercial or foreign application.
3. Motivated by optimistic performance requirements, contractors employed sophisticated analyses to shortcut development expenses, exotic and expensive materials to meet weight and electromagnetic requirements, and novel fabrication and fastening techniques. The production

commitment did not appear to shift initial design emphasis toward maintainability, reliability, and economy; instead, it encouraged over-the-shoulder design monitoring by production engineers to accelerate the production learning curve.

4. Competition and fixed price cost incentives motivate the contractor to obtain supplies and services from the most reliable and economic source. Total package procurement simply shifts the time period for these subcontracts.
5. None of the programs studied have progressed to the point where reprocurement of componentry is required. Competition for subcontracts or components at program initiation, as required by the TPPC, does not appear to preclude the desire for recompetition of component procurement later in the program. Once the contractor has delivered detailed drawings, specifications, and recommended procurement sources, the Air Force (and particularly the Air Force Logistic Command) has all the information necessary to permit competitive procurement from all contractors capable of qualifying the component, total package procurement notwithstanding.
6. One can hardly question the assertion that a commitment established in competition forces the winner to be efficient. To evaluate this statement as it relates to total package procurement, one must only consider the efficiency promoted by the production commitment, since development commitments can be made competitively outside the total

package concept. While production managers may be motivated toward greater efficiency, it is not apparent that the production workers--guided by time standards and union procedures, steeped in the tradition of "another day another dollar," and ignorant of the competition and contractual terms--will be motivated to be more efficient. Two contracts included in this study were subjected to a sufficient number of development design changes that the production price was escalated in a sole-source environment.

7. Using the TPPC, the government can make an award choice based on a firm contractor production cost commitment rather than on an estimate of the probable operational equipment cost. Herein lies one of the true advantages of the total package concept--firm visibility into probable production costs at least on a per-copy basis.

The above conclusions generally run counter to the advantages asserted by the proponents of total package procurement. Whether or not total package procurement will improve weapon system acquisition is much too controversial and pervasive an issue to be settled by the above conclusions. Further observations on the significant issues, derived from the three programs studied, are given in the following paragraphs.

There is little evidence that the total package concept has made progress in moving weapon system acquisition into a competitive free enterprise market system characterized by more than one buyer. Competition in the American

industrial market implies a number of buyers and sellers arriving at independent decisions as to what to produce and purchase, with freedom of entry and exit into the market. Total package procurement not only maintains a more powerful single buyer, but also tends to restrict the number of sellers and potential sellers by requiring a long-term resource commitment.

Intricate specialized technology required for the development of modern weaponry requires high-risk investment that would be undertaken by industrial contractors only to protect their market position or enhance their profits or power. Only the government can provide or guarantee a market for the product; therefore, the government must absorb the major risks of development. It must commit payment for all development by guaranteeing a price suitable to cover costs. It undertakes to buy what is produced before it is developed, or to compensate fully in a case of contract cancellation, thus suspending most characteristics of a free-enterprise market.

Total package procurement will increase the amount of defense dollars competitively awarded, but will tend to decrease the number of competitors for defense dollars--the more important aspect of a free-enterprise society.
Synthetic market mechanisms such as cost and performance incentives, relaxation of government controls, and greater distribution of defense dollars have failed to introduce a semblance of American free enterprise, since these mechanisms are not accomplishing their policy objectives.

Defense agencies appear unwilling to execute changes to a total package system, suspecting that such changes will either alter the initial premises upon which the weapon system was selected or relieve the contractor's financial problems. This attitude stems from an increase in centralized decisions for weapon system selection, based on subjective assessments of the economy, the enemy threat, and technical feasibility of the weapon system. SPOs lack the necessary information to ensure a timely well defined change based on new assessments of an enemy threat--particularly intelligence data and other information reserved for those in authority. Accurate projections of a military requirement or threat are difficult to make, to define, and to precisely convert into performance requirements for strategic weapon system acquisitions. Both an accurate definition of the threat and a statement of performance criteria are unlikely to last the duration of development and operational fielding.

During the contract definition phase, neither funding nor time is adequate to develop the detail required to establish the technical building blocks necessary for a straightforward job of engineering development, as required for a total package commitment. Contractors are required to spend up to three times as much as the government during Phase B of contract definition. DoD directives stress the importance of full funding and of not advertising the amount of funds available for contract definition, yet the government and contractors are well aware of the funds available. They are also aware that minimum RFP responsiveness by contractors will require many times the amount of government funds. The unreasonably short time for Phase B of contract definition is caused

by an imaginary IOC date, and is also significantly shortened by the time delays following the selection evaluation board's recommendation to the source selection committee. Program definition, funding, and schedules appear to be major departures from the requirements of DoD directives covering contract definition.

Cost management data, submitted by contractors at the conclusion of Phase B of contract definition, are much greater than the requirements for source selection. Data could be trimmed to a great degree by eliminating many of the cost data requirements, and by deferring other data to an as-required basis during Phase C negotiations or later. In theory, total package procurements should require less data; however, procurement regulations derived for non-TPPC have led to a proliferation of data, much of which do not lie at the core of the award decision.

Source selection is not based on the initially submitted proposals, as required by DoD directive. Both price and performance were subjected to considerable negotiation during Phase C evaluation and selection deliberations, with the government maintaining the upper hand. Much of the negotiation during Phase C was not to establish a common base of technical performance and cost, but rather to pressure contractors into lowering their cost and increasing their performance, primarily by redefinition of program requirements. This collaboration was generally restricted to very high levels of both government and contractor management.

Technical transfusions during contract definition were negligible. Primary effort was to establish firm system requirements so that contractors could define their own design approach in meeting these requirements. Several changes to the RFP after its release resulted in numerous interface, performance, and specification changes.

Source selection based on the overall life cycle cost effectiveness of the system was beyond the service agency's capability. Ultimate contractor selection was based on a unique combination of technical and management proposals, and was significantly influenced by price and the geo-political considerations necessary to preserve the overall health of the aerospace defense industry.

There was no evidence that the potential of increased profit accompanied increased-risk total package procurement. Price competition forced contractors to unrealistic target cost estimates, diluting the stipulated target fee. Commitments to production, in addition to development, aggravated the long-term prospects for increased contractor profits, but resulted in a better initial price to the government. The breakeven point dictated by the ceiling on cost overruns was the strongest contractor incentive. Sharing ratios for cost underruns were too shallow to be motivating and beyond any reasonable expectation of the contractor, whose confident estimate of target costs were well over the contractual target costs. Performance incentives provided no profit visibility, since performance guarantees were difficult to achieve.

Total package procurement awards have been made on programs whose threshold of allowable risk has been exceeded in cost, technology, and performance aspects. The contract definition phase has fallen short of defining the technology and total program needs required to realize the principal benefits of total package procurements. Adequate priority has not been given to the method of procurement following Phase B of contract definition.

TPPC incentives are neither rewarding efficiency nor punishing inefficiency. They serve a beneficial purpose, however, by providing greater latitude for the extra-contractual SPO pressures (perhaps the most significant motivating force) and by favorably altering the contractors' day-to-day method of doing business by increasing his awareness of the areas of greatest concern to the customer. Total package procurement has little bearing on this observation.

Management systems appear to be evolving at cross purposes with the overall total package concept. Government program directors are requiring management reports as specified by existing manuals, without determining whether departures or waivers are warranted on total package programs. Much of the contract data supplied is not needed, and the Air Force cannot provide the required approval in a timely fashion. Under the total package concept, there is considerable controversy as to whether document approvals constitute action which revokes prior contractor-Air Force commitment. Contractor management reporting required by government controls (particularly CSPCSS) has been increasing rather than decreasing. This appears to be the trend in general, and is not a result of total package awards. The government justifies this increased

control as necessary to gain visibility into contractor activities. However, the basic tenets of the TPPC are a fixed price contract for a well-defined, well-thought-through program, with special clauses to discourage changes. The rationale for applying CSPCSS runs exactly counter to these tenets, and the existing controls do not appear effective for TPPC contracts.

Disengagement is not occurring to the extent necessary for contractor total responsibility. It appears that the major resistance to such disengagement is coming from government laboratories and non-profit organizations that provide technical direction. Both restraint and excessive involvement have injured programs. The ineffectiveness of disengagement results from the dissolution of a long-standing partnership arrangement, and from poor system definition. It is literally impossible for technical direction to be avoided when program changes become the way of life during development. This negates an advantage of total package procurement--associated disengagement. Total package procurement is not the only acquisition technique which encourages disengagement--competition and fixed price incentive contracts are also aided by disengagement. TPPC simply makes the requirements of disengagement more important.

Separate funding for development and production of total package programs is inconsistent with the single price commitment. Target costs, well recognized to be fictional, nevertheless represent the level of budgeted funding for which the contractor is reimbursed. This is further complicated by the DoD budgeting and funding to the published target cost data, even though the final cost is

expected to be higher. Moreover, the government has a commitment to the contractor to pay up to the ceiling price, but refuses to recognize this in its budgeting process. This results in a persistent lack of money at service headquarters-- sometimes leading to curtailment and postponement of critical changes in program development.

Competitive promises of performance and fixed price incentive contracts with firm commitments to production appear to be stifling the imaginative resources of designers and engineers. Tight target costs and ceilings tempt contractors to use technical shortcuts. Engineering innovation to meet performance specifications is only undertaken to the extent that it might help meet the minimum requirements; any attempt at further innovation is not seriously entertained. Confirmed innovators are spending more and more time on schedule and cost aspects rather than attempting to achieve the best technical performance on a program.

Contractor total systems responsibility is impractical on programs with performance requirements stated in qualitative and unmeasureable terms relative to the overall mission. Contractor promises of optimistic performance estimates are aggravated by government negotiation pressure to increase performance achievement even at the risk of decreasing confidence. While the correction-of-deficiency clause is designed to enforce minimum performance, delays by the contractor in making a commitment to these performance incentives complicates enforcement. Government furnished equipment and products present another opportunity for the contractor to abrogate his total responsibility,

leading to many changes in the program. Performance and specification changes, along with detailed technical direction and system interfaces, also mitigate against contractor responsibility.

On new development programs, definition of life cycle costs by the contractor and evaluation of these costs by the government lie beyond the capabilities of either. One of the major difficulties is the inability of contractors to predict accurately equipment reliability and maintainability. Logistic costs for corrective and preventive maintenance lie beyond the control of the supplying contractor, and could not be sufficiently defined by the government to allow for an overall operating cost technique. Ancillary equipment, such as AGE, spares, and training, was priced with the most uncertainty and greatest contingency of the entire total package contract.

A discernible lack of agreement exists between field-level and senior Air Force procurement personnel on the proper application of the total package concept. The field officers are treating the total package concept as an edict from higher authority and as a lever in increasing competitive fixed price incentive contracts. They have not been motivated by policy statements on the proper use of total package procurement. Contractors recognize this resistance by SPOs, but have been required to bid to stay in the defense business.

These conclusions may be interpreted as a ceremonious burial for the total package concept, but must be taken in the context in which they were introduced at the outset of this chapter. The C-5A program is a relatively successful

application of the total package procurement concept, compared to the Mark 17 and SRAM programs. The above (underlined) conclusions are not entirely applicable to the C-5A program. The principal negative observations applicable to the C-5A are optimistic performance estimates, unrealistic target costs, profits not commensurate with risk, unrealizable incentives, high contingency logistics costs, excessive cost information requirements, and excessive monitoring. Most of the above findings apply equally to the Mark 17 and SRAM programs. A further complication is that most of them apply generally to competitive fixed price incentives rather than to the total package concept itself. Total package procurement simply aggravates a situation which would exist with competitive development-only fixed price incentive contracts.

Many of the ills attributed to the total package procurement concept really belong to the concept's definition. Policy statements made by its developers have been much too broad and have attempted to embellish the basic competitive aspects of total package with many clauses to achieve greater advantages. A single basic and desirable advantage of total package procurement is the firm visibility to the government of as much of the production and operational costs as possible at the outset of development. This goal has been encumbered by many special provisions to achieve objectives which are not basically attainable for programs requiring technology beyond that which is available at the end of contract definition. Stringent correction-of-deficiency clauses, change restrictions, total responsibility, and disengagement, serve only to detract from the efficient performance of both the SPO and the contractor.

A more limited objective--i.e., to make an award decision based not only on development costs but on probable costs of production and operation--should be the goal in total package procurement. This is the challenge which contractors should be ready to meet. Whether the commitment should be bundled into one single contract rather than two separate contracts (one for development and one for production) depends primarily on the amount of development effort in relation to the total weapon system cost. Whenever possible, the government must have contractor commitment to production costs to make a proper selection of weapon systems and a proper decision to proceed with development.

RECOMMENDATIONS

Total package procurement must be restricted to those systems which are generally independent of any major system and which are an entity themselves. Furthermore, it must be restricted to programs whose system effectiveness can be well defined in quantitative terms at the conclusion of contract definition. Candidate programs should also have a very low probability of change during the course of development and initial operational deployment. These restrictions would apply to the C-5A development.

Programs whose qualitative system performance parameters are based on assessments of enemy capabilities, and therefore not capable of being measured without invoking enemy hostility, are not likely candidates for total package procurement. Multiple and/or concurrent interfaces, undefined at the time of contract definition, also mitigate against the use of the total package concept.

Programs entering into development which involve unproven technology from an operational measurement point of view, are unlikely candidates for total package, as are programs whose development cost is expected to be 20 per cent or more of the overall first-generation fielding cost of the weapon system. New weapon system concepts invariably fall into this latter category.

On second-generation systems or later, weapon system improvement involving components, reliability, and maintainability should be made under a total package concept which includes retrofitting. Unfortunately, the initial weapon system developer can generally provide the lowest price. Nevertheless, the procurement can be made in a single package, including both development and production. Strategic weapons, such as SRAM and Mark 17, are not good candidates for a total package procurement. However, they do not preclude the government's need to have a better feel for production costs when awarding a development contract (which should be the prime objective of total package procurement). This objective can be accomplished by awarding two separate contracts at the outset of development, with incentives strongly favoring cost efficiency. If, at the end of contract definition, interfaces, performance criteria, and mission requirements are diffuse, a cost plus incentive development contract should be considered, along with a separate fixed price incentive contract for production. Changes in development programs can have their production assessments in due time, providing the government with an adequate update of production and operational costs for planning and budgeting purposes. A CPIF development procurement motivates the firm's engineers to devote their time to

developing the best weapon system from strictly the technical and performance aspects. It is difficult to conceive that fly-off procurements will be used for strategic weapon systems that can be deployed only in the event of a nuclear war. Procurements involving development costs which are only 10 to 15 per cent of the total operational cost will probably be limited to tactical weapons that are expended in limited warfare and isolated hostilities.

The following comments, although applicable to total package procurement, are also applicable to all types of procurement involving competition during the contract definition for incentive and fixed price contracts.

- Government laboratories and non-profit organizations should shift most of their effort to the concept formulation phase and to Phases A and B of contract definition to better define the work statements and the contractual requirements, concentrating on systems engineering trade-off studies, design concepts, and tailoring of contractual data needs to the requirements of the specific weapon system development.
- Contract definition proposals should be evaluated and contracts should be awarded on the merits of the initial bid.
- The government should provide suggestive collaboration during the contract definition to ensure a proper baseline for competing contractors.
- During contract definition and subsequent development, contractors should place increased emphasis on the producability of weapon systems.

- Government procurement personnel must be convinced that changes are mostly a result of new information necessary for the operational mission success of the system rather than inadequate initial definition.
- Contractors serious about entering a contract definition Phase B for new weapon system programs should shift more resources to the concept formulation phase. Presently less than 10 per cent of the technical manpower required during contract definition is employed during concept formulation. The short period of contractor participation for contract definition has led to massive buildups of technical power, resulting in inefficient utilization of talent and inadequate systems definition.
- Weaponry development is uncertain, requiring the firm to seek the help and protection of the government. The government must understand that it alone must absorb the risk and guarantee a market for a product that has not even been developed. In doing so it must underwrite the development cost, for it has the ultimate responsibility for national security.
- The contractor will innovate in a competitive free enterprise system only when he can find more than one buyer and also establish his own price.
- Contract definition time and funding must be increased by the government to ensure that requirements are sufficiently spelled out to avoid costly contractual changes and to comply with existing directives.

- Proposal data requirements are much too excessive for total package programs, and should be trimmed by the procuring agency before imposing the standard procurement regulations on new RFPs.
- Phase C of contract definition should be considerably shortened by greater involvement of the source selection committee during the evaluation process, to decrease the significant delays subsequent to a recommendation by the selection evaluation board.
- The Air Force Logistics Command and the using agencies (SAC and MAC) must become more involved in the contract definition of weapon systems to ensure complete and adequate definition of mission performance and logistic requirements.
- Contracting officers must be made aware of the profit structure of the defense industry relative to the commercial business of these firms, and must be more communicative with senior-level procurement officials to ensure that the philosophies of procurement are not distorted at the field level.
- Cost incentives must provide greater inducement for contractor management to reduce costs, and should concentrate on significant return to the contractor for efficiency. Performance incentives must be meaningfully tied to definite measurable parameters, and must be geared to the overall mission success of the system; otherwise they will not work. They must also be adjusted throughout the program to be current with the changes instituted for improvements in design.

- Competitors should be allowed to specify their fees and sharing ratios on all contracts, and the government should provide guidance limits for ceiling prices.
- Developing management systems are at cross purposes with the evolution of fixed price incentive contracts. The government should take the initiative to sift out unnecessary regulations that are imposed upon total package contractors. The government should also define more explicitly what is wanted in terms of overall information, rather than providing detailed guidance in the preparation of specific reports.
- Programs subject to numerous changes (i.e., performance and/or specification diversions from the initial contract), unless they can be explicitly defined by the government, will probably result in re-engagement of government technical people in non-profit organizations. Such engagements will constitute a partnership in the development of the weapon system.
- Contractors must better define the total extent of impact of government-directed changes.
- Increased emphasis and funding must be provided for exploratory and advanced development programs to balance the shortcomings of technical innovation in total package procurements.

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APPENDIX A

PERSONAL INTERVIEW GUIDE

TOTAL PACKAGE PROCUREMENT

- A. Proponents of the total package believe that it offers the services several major advantages over traditional sequential-type procurement in which a development contract is signed, then an initial production buy is made.

Please comment on the following declared advantages.

Do you agree?

Has your past experience supported the statements made?

Does your present experience validate the stated advantages? If not, where are the disagreements?

1. It prevents "buying-in", the practice of bidding unreasonably low on development, and expecting to "get well" on a non-competitive production contract.

2. It deters contractors from making extravagant promises on performance, because they must bid on production before development even begins; it also forces them to tighter discipline to keep costs down; claims will have to be backed by a readiness to produce -- or pay. No "brochure-manship" is allowed.
3. It increases the likelihood that prime contractors will try to hold down their costs by calling for competitive bids on supplies and subcontracts.
4. It forces contractors to accept greater risks in return for wider profit savings and fewer administrative and auditing controls.
5. It should provide a better price, both for development and production, since it calls upon the prospective contractors to sign binding contracts for the total package while still under the umbrella of competition.
6. It forces the services to "think through" a program to determine just what it wants, even before the completion of the contract definition phase, and in this regard provides a built-in self discipline.

7. It tends to assure a stabilized, economical design. A contractor isn't going to propose a "gold-plated" design and keep coming in with platinum-plated refinements during the development and early production cycle if he knows he is going to foot the bill for the changes.

B. The total package receives criticism from both within and outside the Defense Dept. Some members of the USAF's air staff can also be counted as detractors. Among the critics views are the following. Please comment.

1. It inhibits technical innovation. A contractor will remain quiet even when he sees changes or modification that could be made to gain substantial improvements in performance, particularly when the improvement is not incentive fee-bearing, or "VECP-able".
2. Evaluation of contractor bids is beyond the service agency manpower capability in order to conduct widespread prompt response.
3. Services are unwilling to discipline themselves to the point where they will not intervene unnecessarily in the prime contractor's day-to-day effort to meet the rigorous commitments for which he has contracted.
4. Technological risk aspects are not adequately assessed in earmarking programs for TPP. The TPP must be a low-risk, straightforward undertaking, well within the current state of the art, both from aspects of technology and performance goals.

5. Incentive and penalty clauses must be more imaginative and flexible. They must be tailored to give the contractor maximum motivation to meet the terms of his commitment on time.
6. The required bid data, especially item-by-item fiscal-year breakouts, are far voluminous and not really required in making an award decision in fixed price TPP.
7. Technical transfusion of any consequence, following the CDP, is impractical because it necessitates major system redesign to incorporate a transfused item of any significance.
8. The bidder's proposal is required to contain data on many peripheral issues that do not lie at the core of decisions of the source selection board. Many items requiring only verification and validation are not subject to meaningful analysis and point scoring.
9. Prime contractor effort during the CDP is supposed to be equally and fully funded per DoD Directive 3200.9. Funding is never adequate since all contractors spend considerably more than the contract price in order to be totally responsive.

C. The following are not necessarily to be considered statements of fact. They are designed to provide guidance and structure to the interview.

1. Neither government nor industry is adequately prepared for incentive-type contracts.

What preparations do you feel are necessary

- a. for incentive contracts?
- b. for fixed price contracts?
- c. for TPPC contracts?

2. The services are entertaining TPPC contracts simply because top pressure is being applied.

If so, where is the pressure coming from?

If not, how do you explain the apparent controversies at air staff level?

3. Contractors are bidding TPPC contracts only to "stay in the game".

If not, how do they justify the bid in light of claims of substantial risk and low return to the corporation?

If so, what benefits can be seen for the future?

4. AFSC-employed systems engineering and technical direction (SETD) must assume a different role in TPPC contracts.

What new roles would you suggest?

5. In return for relaxation of controls, the services have asked for increased management visibility.

Have controls really been relaxed?

Does "increased management visibility" stifle the contractor's desire to assume greater risk?

6. The rank-and-file of industry and government are unaware of and have demonstrated no different work habits under the FPI/TPPC contract than under the previous cost reimbursement atmosphere.

Are changes necessary in the rank and file?

If so, what are they and how do they come about?

7. In order to define performance requirements in detail and with a high degree of accuracy, more extensive effort and time must be provided for in the CDP.

Have CDPs been adequate? -- in funding? -- in time? -- in defining a straightforward job of development?

8. The "correction of deficiencies" clause in FPI/TPPC contracts is a red herring raised by contractors to shield their unwillingness to change.

Has this clause created a financial burden on previous CPI contracts?

Do you expect any problems on this contract?

Do you feel the government would really attempt to enforce it?

Or is it so loose as to be unenforceable?

9. An increasing number of major subcontractors are complaining that their TPPC primes are requesting more detail data than are required either by any other programs, the government, or by contract.

Have you experienced these complaints?

Are primes using the TPPC environment to elicit proprietary data?

Is more subcontract data actually required?

10. Contractors and service agencies must operate in an atmosphere that avoids rigid inflexibilities--they must live to the spirit rather than the letter of the contract.

Can this philosophy apply to FPI contracts? -- to TPPC/FPI contracts?

Has it ever really worked?

What procurement levels are more willing to attempt to operate in this atmosphere?

D. This series of questions attempts to isolate some specific TPPC problems facing government and industry. A consensus of answers may provide insights to the future.

1. What new management techniques were instituted specifically for the execution of the TPPC contract under AFSCM 375 series of management procedures? -- or any internal procedures?
2. Are there any conflicting or duplicating system requirements between the AFSCM 375 series of management procedures and other service (BSD, ASD, ESD) requirements?

Specifications
Financial Data
Management Information

3. What training is necessary to condition both government and industry in order to create the proper attitude for FPI/TPPC?

What goals would be desired in changing working habits from a CPFF to FPI/TPPC environment?

4. What type of organizational structure best fits the demands of TPPC contracts?

Functional _____ Project _____ Matrix _____

Comments:

5. What corporate and government measures are required to effectively administer a TPPC contract when a design and development division is a separate profit center from the producing divisions?

Have these measures been successful?

If not, what changes would be recommended?

6. Do you feel that a dollar floor on contract changes, such as the \$100, 000 min. on the C-5A, stifles innovativeness?

Are these floors realistic?

Do you have any?

What modifications are recommended?

7. Have the contract changes been adequately defined to insure program assessment of production and support effort?

Has response time been sufficient?

8. Was the TPPC contract "properly" awarded per Air Force precepts?

Was it properly administered? -- or should changes in methodology of customer/contractor relationship be made?

If so, what major changes?

Does TPPC suggest a better way?

9. Do you feel that sub-systems requiring multi-technical, management, and inter-service interfaces, beyond control of the prime, are adaptable to the TPPC?

What special conditions must exist?

During CDP?

During the acquisition phase?

10. Are any special considerations due a prime contractor when directed to incorporate government furnished equipment (GFE) in his system and subsequently assume responsibility for total system performance?

Is total responsibility practical?

How are GFE changes handled?

11. Can you define problems that specifically relate to your present FPI/TPPC contract and work statement? Are they products of the fixed price, incentive, or TPPC provisions (such as weight, dimensions, payload, power plant, configuration, criteria, etc.)?

Contractual --

Technical --

Performance --

Management --

12. What changes would you make in management, pricing, or technical aspects of future FPI/TPPC proposals?

For CDP?

For Acquisition?

13. What aspect of the present work statement and contract would you now want to change?

14. What fields of investigation would you suggest in order to better define the groundrules of FPI/TPPC in order that goals of both industry and government be met?

Interviewee: _____
Name _____ Title _____ Program _____

Date:

Interviewer: Albert J. Gravallese, Sloan Fellow
MIT Sloan School of Management
Cambridge, Massachusetts

Information derived from this interview will
not reveal the source without express consent
of the interviewee.

APPENDIX B

PROCUREMENT ELEMENTS--C-5A

PROGRAM DESCRIPTION

The Air Force has turned to the C-5A because the piston planes that have comprised most of its cargo fleet are becoming too old and too uneconomical to operate. Also, the C-141, a Lockheed jet-powered military freighter, can accommodate only a small portion of airlift traffic. As for war-time cargo, about one-third of an Army division's present equipment will not fit through the doors of the C-141. The C-5A will be the biggest of all military transports. It will be more than 245 feet long and 65 feet high at the tail (six stories high), and will have a 222-foot wing span. Its gross weight will be 364 tons, twice that of commercial jet planes. At 460 knots airspeed, it will be able to carry loads of 200,000 pounds over a range of 2,700 miles, or loads of 100,000 pounds non-stop for 5,500 miles. A wartime overload of 265,000 pounds can be carried 2,500 nautical miles.

The big transport jet combines the marked economies of very large aircraft with an extremely powerful engine and a weight-supporting landing gear of 28 wheels that will permit operating into small, primitive forward bases. The C-5A will accommodate both the heaviest and bulkiest of the Army's equipment--from the 128,420-pound M-48 mobile bridge launcher to the UH-1 helicopter. The cargo compartment will be 19 feet wide, 13-1/2 feet high and 145 feet long. An upper deck will provide seats for twenty crew members and about eighty people traveling with the equipment.

The jet is primarily a cargo-carrying rather than troop-carrying plane, but is big enough to accommodate up to 600 soldiers with their rifle packs and other small arms. The plane will have both front and rear exits for loading and unloading; trucks and tanks can be driven through the plane from front to rear, greatly shortening handling time. For the front opening, the nose of the plane is hinged like a visor. The Air Force has specified that the plane must be able to land, unload, reload and take off within an hour. It will be powered by the largest jet aircraft engine ever made, and will have the lowest fuel consumption, in relation to its power, in the free world. Each of the four engines on the C-5A will be in the 40,000-pound thrust class compared to about 18,000 pounds of thrust in today's most powerful jet aircraft engines.¹

SCOPE OF EFFORT

The RFP work statement called for the identification and preparation of performance specifications for each end item required for an operational system, as well as a price proposal for development, production, and selected logistic support needs. Logistic support requirements included all required base-level aerospace ground equipment (AGE), training equipment, and contractor technical services, together with spares and maintenance through the Category II (Air Force and contractor participation) test period. Operational spares beyond Category II would be added to the contract by provisioning action and would be priced in accordance with a detailed pricing exhibit contained in the contract.

¹"C-5A: Lockheed's Path to the Future," Business Week (October 9, 1965), 32-33.

SCHEDULES

The Request for Proposal (RFP) was issued December 11, 1964. The RFP contained, among other things, a work statement and model contract for contract definition (CD), and a work statement and model contract for development and acquisition. The RFP was issued to three airframe and two engine contractors who had participated in a funded parametric study leading to the approval of the C-5A program. The Air Force felt that no firms other than those engaged in the parametric studies could be responsive within the time element; therefore, Phase A of the contract definition process for the airframe was eliminated. The three competitors for the airframe were Boeing, Lockheed-Georgia, and Douglas. The two contract-definition engine contractors chosen were current technical development program contractors--Pratt and Whitney, and General Electric.

The contract definition phase started December 31, 1964. Each of the five contractors entered into a contract definition contract at this time. Technical proposals were received by the Air Force on April 20, 1965 and cost proposals on April 27, 1965. During Phase C of contract definition, each of the five contractors had signed a fixed price contract for the research, design, test and evaluation (RDT&E), and delivery of 58 total systems in addition to logistic support. On September 30, 1965, an award was made to Lockheed for the airframe and General Electric for the engines. The period of performance for the entire contract runs essentially from October 1, 1965 through 1974, with the test and evaluation of eight planes starting in March, 1968. Roll-out of the first plane took place on March 2, 1968, with President Johnson attending the ceremony.

RFP SPECIFICS

Competition Groundrules

Item 3. The competition for the acquisition phase will be based on the overall cost effectiveness over a 10-year operational period of a system which complies with Air Force stated requirements. Competition will cover not only development but also production and support.²

Award of a contract would be made to the source whose cost and technical proposals, as evaluated by the Air Force, demonstrated the greatest overall cost effectiveness over a 10-year operating period of a system complying with all of the minimum performance requirements established in the RFP. To this end, the contractor was required to prepare a 10-year operating cost estimate on certain given assumptions. This was to be added to the RDT&E and production costs, and compared with the productivity of the proposed system over the same period. Although the initial production airframe buy was only 58 systems, a priced option was obtained on 57 more, and costs and productivity for source selection purposes was to be computed on a buy of 115 total operational systems.

Item 4. Competition will be based on a total package life cycle performance/cost assessment of the firm proposals submitted, with particular attention directed to the work through production runs A and B. The target cost in winning competitor's contract will remain firm (except for changes in work itself and abnormal economic fluctuations) throughout the program, and the contractor's proposed performance will become contract minimum requirement assured by correction-of-deficiencies clause application.³

²Extract from letter 64ASZX-748, dated December 11, 1964, from ASD Headquarters to competitors.

³Ibid.

Priced options in both the airframe and engine contracts will enable the government to order up to 57 additional total systems, and formula options can be exercised to order up to 85 additional systems beyond the priced quantity of 115. Each contract provides for a target profit equal to 10 per cent of the target cost and a ceiling price equal to 130 per cent of the target cost. Priced options will be added to targets and ceiling as they are exercised, as will provisioned spares. The final incentive fee computation will be made on the basis of up to 115 total systems and support. The formula option for an additional 85 total systems is to be exercised in a separate fixed price incentive contract with a 10 per cent profit and a 120 per cent ceiling price.

Escalation and Ceiling Cost Arrangements

Item 5.

- A. The contractor should receive protection against abnormal economic fluctuations caused by law or general economy of the nation.
- B. An abnormal fluctuation is one which is approximately one half again as great as average fluctuations during the past ten years.
- C. Ceiling price, therefore, of 130% of target price is appropriate in spite of risks inherent in the total package commitment of this kind.⁴

Both the engine and airframe contracts contain an escalation clause to protect against abnormal fluctuations in the economy (beginning January 1, 1968). Both contracts contain a clause providing for adjustments to targets

⁴Ibid.

and ceilings in the event of changes in the federal laws affecting labor-associated costs and a clause providing for limited adjustments in the option prices if actual production costs on the first 53 operational systems deviate substantially from the originally targeted production cost (five of the first production units are built with R&D money).

Cost Sharing and Incentives--Three Alternatives

Item 6.

- A. Fixed contractor cost share of 15% above target and 50% below target.
- B. Fixed contractor cost share of 30% above target and 50% below target.
- C. Flexible contractor cost share beginning at 15% above and below target and capable of being unilaterally increased by the contractor to a maximum of 41-1/4% above and below target.⁵

Both contractors proposed on the basis of three alternate cost incentive formulas: 85/15 over target and 50/50 under; 70/30 over target and 50/50 under; and the flexible incentive with an initial share of 85/15 over and under target.

Explanation of Cost Incentive Alternatives

Item 7. The concept of total package program on which targets will remain firm throughout involves a substantial cost risk. This risk is directly related to the contractor's cost share ratio and can, up to the ceiling price, be reduced by reducing that ratio.⁶

⁵Ibid.

⁶Ibid.

Priced options in both the airframe and engine contracts will enable the government to order up to 57 additional total systems, and formula options can be exercised to order up to 85 additional systems beyond the priced quantity of 115. Each contract provides for a target profit equal to 10 per cent of the target cost and a ceiling price equal to 130 per cent of the target cost. Priced options will be added to targets and ceiling as they are exercised, as will provisioned spares. The final incentive fee computation will be made on the basis of up to 115 total systems and support. The formula option for an additional 85 total systems is to be exercised in a separate fixed price incentive contract with a 10 per cent profit and a 120 per cent ceiling price.

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Both the engine and airframe contracts contain an escalation clause to protect against abnormal fluctuations in the economy (beginning January 1, 1968). Both contracts contain a clause providing for adjustments to targets

⁴Ibid.

Integration of Engines and Other GFE

Item 10. The airframe contractor will include responsibility over performance and operation of aircraft as an integrated system including engines and other government-furnished equipment (GFE) determined by the Air Force to be critical to the system and expects the airframe competitors to negotiate responsibility for increments thereof. Agreements will be incorporated in both airframe and engine or other GFE contracts.⁸

Therefore, the airframe contractor is responsible for the performance of the aircraft as an integrated system, including the engines. Since the engines are government furnished, it was necessary for the airframe manufacturer to negotiate an agreement with the engine manufacturer under which the responsibilities of the manufacturers to each other are specified. Thus, the Air Force, although buying the engines direct and furnishing them to the airframe contractor, can look to the airframe contractor if the airframe/engine combination does not meet its performance in the air.

Specification Changes

On individual changes up to \$100,000 there will be no adjustment in the target cost or ceiling price. On changes over \$100,000, there will be a target price and ceiling price adjustment, including a profit not to exceed 10 per cent, until all such changes total 3 per cent of the initial target cost. Thereafter, the profit increment cannot exceed 2 per cent. The intent of these provisions is to discourage the contractor from proposing unnecessary changes. On individual changes exceeding 1 per cent of the initial target

⁸Ibid.

cost, this 2 per cent profit limitation will not apply, because a change of this magnitude would represent a significant departure from the initial work statement, and could carry target profits to as high as 10 per cent of the negotiated change cost target.

Facilities

The contracts will not provide for the construction or provision of additional government facilities beyond those presently used by the contractors.⁹

Production Acceleration

The contractor may accelerate production to cut cost, although the Air Force need not accept early deliveries.¹⁰

Relaxation of Government Controls

The contractors must specify each target cost reduction for data submission relaxations, technical direction relaxations, approval requirements relaxations, and the procedural constraints relaxations.¹¹

Funding

Contracts provide for 90% progress payments during the RDT&E and production effort until such time as payments for hardware deliveries have reduced the contractor's unrecovered costs to a stated amount, after which future progress payments will be made at 70% of total costs.¹²

Correction of Deficiencies

Correction-of-deficiency clauses in both contracts extend the time period in which deficiencies in the total system may be discovered, to

⁹Ibid.

¹⁰Ibid.

¹¹Ibid.

¹²Ibid.

include an adequate opportunity for utilization of each item of hardware in an operational environment. The costs of correcting such deficiencies are allowable under the terms of the incentive contract, but no adjustments are made in target or ceiling price. Performance subject to the correction-of-deficiencies clause, and becoming minimal accepted contract standards for the winning contractor, are the following:

1. Weight empty
2. Payload/Range
3. Takeoff distance
4. Speed
5. Landing distance
6. Reliability
7. Maintainability
8. Initial cruise altitude

In recognition of the potential for disputes between the airframe and the engine contractors as to the responsibility for correction of deficiencies in the total system arising in an operational environment, and the resultant difficulty in assessing responsibility as between the two prime contractors, the airframe contract provides that, given the airframe contractor's concurrence in the original engine specifications, any changes thereto, and the demonstrated compliance with those specifications, the airframe contractor will, as to the government, assume responsibility for correction of any deficiencies in the total system. The Air Force has agreed to allocate costs of correcting such deficiencies between the contracts as determined by the airframe and engine contractors pursuant to an agreement to which the government is not a party.¹³

¹³Ibid.

Termination

Although each contract calls for an RDT&E and production effort covering several years, a limitation on the government's total liability in each year has been included. This establishes a ceiling in the event of "termination for convenience" in that year.

NEGOTIATED CONTRACT SPECIFICS

For the total package, including the 58 planes, Lockheed's bid was \$1.662 billion and Boeing's was the highest bid of \$1.955 billion. This represented the maximum price the government might have to pay, assuming an overrun of 130 per cent. This means that the Lockheed target cost would be approximately \$1.28 billion. Final award, Contract AF33(657)-15053, was made to Lockheed at a target price of \$1.4 billion including the 10 per cent profit. Since Lockheed was willing to accept a 70/30 overrun share and the consequently greater risk involved at a relatively small increase in target price, the Air Force, on January 3, 1966, exercised a 70/30-50/50 formula for the airframe contractor.

The General Electric contract for the TF 39 C-5A engines is for a target cost of \$417 million plus a 10 per cent profit and a 130 per cent ceiling, with an initial 85/15 sharing ratio and flexible incentive.

APPENDIX C

PROCUREMENT ELEMENTS--SRAM (AGM 69A)

PROGRAM DESCRIPTION

This program was originally conceived in the latter part of 1963 to provide a short-range attack missile (SRAM) for use on late-model B-52 bombers and potentially on FB-111 bombers. The program is classified; therefore, many of the details concerning its mission and schedules cannot be included in this appendix.

SCOPE OF EFFORT

The RFP provided for a competitive contract definition (CD) leading to the award of a total package contract for design, development, and production of missiles, aircraft structural and electronic modifications, and some elements of logistic support.

SCHEDULES

Early in the summer of 1965, the program was approved for a contract definition phase. In August of 1965, a preliminary RFP for the SRAM procurement was prepared by the Air Force. In September of 1965, prior to the release of the RFP, the program underwent a final Director of Defense Research and Engineering (DDR&E) review. At that time, it was decided that the missile program should be redirected to emphasize the FB-111 as the primary carrier vehicle. Of the contractors responding to the RFP for the CD, two were awarded fixed price contract definition contracts of \$2.75 million each in December of 1965. Because of schedule constraints, the contractors were allowed to use costs accumulated since November 15, 1965. Technical and cost proposals for Phase II (the acquisition phase) were submitted on March 15, 1966. In November of 1966, a contract award was made identifying a period of performance until July 1970, with December 1967 being the earliest possible initial delivery date.

RFP REQUIREMENTS

Competition

The ultimate purpose of this competition is to select a contractor for acquisition phase which will cover not only development but also production and support; therefore, the RFP places emphasis on the requirements for proposal C. In addition to spurring the lowest cost to achieve the required performance on schedule, this total package should:

- a) largely eliminate buy-in bidding on costs, schedule, and total performance;
- b) motivate winner to emphasize simplicity of production, design, maintenance and reliability;
- c) motivate obtaining supplies and services from most efficient suppliers.¹

Production was not part of the basic work contracted--it was an option or one of several alternate options. However, a total responsibility clause for performance, including correction of deficiencies, was included.

Total Package Concept Exception

Although the original order may not include all operational systems, and work finally ordered, options establishing target cost and other provisions pertaining to any such additional systems and work will be written into the contract, and will be considered as firm as the target cost and provisions pertaining to the original order. Thus, competition will be based on a total package performance /cost assessment of the firm proposal submitted for Phase II with particular attention to work through production runs A and B. Target cost will remain firm through the program and contractor's proposed performance will become contract minimum requirement to be assured by application of a correction of deficiencies clause.²

Escalation and Ceiling Price

Related to the above are the escalation, ceiling and cost incentive arrangements in the proposed contract. The winning contractor will receive protection for cost incurred after

¹Extract from the RFP transmittal letter ASZR, dated July 29, 1965, RFP-33-657-65-5080 from ASD Headquarters to competitors.

²Ibid.

January 1st of 1969 against abnormal, economic fluctuations. An abnormal fluctuation is 1-1/2 the average fluctuation over the past ten years. Protection is also afforded for changes in the law having an impact on labor costs.³ The ceiling price will be 130% of the target cost.

This economic escalation clause is identical to the one established for the C-5A.

Cost Sharing

The flexible contractor cost share shall begin at 20% above and below target and capable of being unilaterally increased by the contractor to a maximum of 50% above and below target. Since the election period begins on the date of the earliest request for progress payments, showing costs incurred in excess of 25% of target costs, a composite contractor cost share is a maximum of 42.5% above and below target.⁴

The cost risk in total package procurement is directly related to contractor cost share ratios and can, up to the ceiling price, be reduced by reducing that ratio. If an initial low ratio can be increased unilaterally by the contractor, he should be motivated to exercise ratio change by prospect of increased profit, which will result in lower total cost to the government. The cost sharing is such that the incentive share is initially established at 80/20. A flexible incentive plan is provided for unilateral upward adjustments of the cost share to 50/50 by the contractor.

Performance Incentives

Each bidder will submit a proposal setting forth the highest standards expected to be attained in weight, range, speed, reliability, delivery, maintainability, etc. The contract awarded to the winner will incorporate the proposed standards as minimum acceptable contract standards.⁵

³Ibid.

⁴Ibid.

⁵Ibid.

These minimum standards will be subject to the correction-of-deficiencies clauses. A separate incentive clause is contained in the SRAM program contract which pertains to the radar cross section performance. A complex formula relates the radar cross section of the missile to several frequency bands, polarizations, and aspect angles.

Total System Responsibility

The missile system contractor will be responsible for the performance of the AGM 69A system/carrier aircraft as an integrated system with responsibilities specifically identified. The contractor will be required to propose such technical and management controls and procedures as he feels are necessary to fulfill his responsibility.⁶

Considering the fact that Boeing had developed the B-52, the SRAM/B-52 RDT&E interface was within the SRAM-contractor total responsibility. On the other hand, the FB-111/SRAM interface required that the government specify the necessary relationships on the interface, since the carrier aircraft was being developed by General Dynamics.

Facilities

Except for existing government-furnished facilities, the contractor was required to furnish all facilities, including modernization equipment.

Relaxation of Government Controls

The Air Force will consider requests for relaxation of specific controls but each request must specify the related change and target cost effect.⁷

The Air Force, as part of its disengagement procedure, is moving quickly to eliminate approvals and controls normally imposed on contractors during the R & D and production process. Detailed design approval will

⁶Ibid.

⁷Ibid.

not be undertaken by the government during the contract period and, although design reviews will be held and design presentations will be made to the government, no formal approval will be required or forthcoming. The design of the missile carrier aircraft and electronic modifications will not be contractually established until completion of first-article testing.

Funding

Production Funding. The contractor will arrange production portion of the Phase II proposal so that the contract may be incrementally funded or with production, awarded on a fiscal year basis. For any Phase II contract resulting from participation in Phase I, the government contemplates the following progress payments: RDT&E, 90% progress payments with a liquidation rate (LR) of 81.8% for RDT&E through completion of category II testing during Phase II; Production, 70% progress payments with LR of 65.3% for production requirements during Phase II.⁸

Changes

A lower limit of \$100,000 is established on target cost change, except for the VECP's and correction-of-deficiencies changes. For changes over \$100,000 but under 1 per cent of the target cost, the target profit, ceiling price, and target cost will be adjusted.

IMPORTANT ELEMENTS RELATIVE TO THE OPTIONS

The RFP, as finally released, provided for a competitive contract definition with prices to be submitted on the basis of the alternative options as outlined in the following table:⁹

⁸Ibid.

⁹Total Package Procurement Concept, Synthesis of Findings, LMI Task 67-3, Logistics Management Institute, p. 106.

Option	Production Lot A	Production Lot B
(1) B-52/FB-111 missile, both carrier aircraft and electronics modifications, AGE, training equipment and contractor support through Category II test.	A quantity of missiles, B-52 carrier aircraft, electronics mod kits, missile-peculiar and peculiar B-52 AGE, and training equipment.	A quantity of missiles
(2) FB-111 missile, carrier aircraft and electronics modifications, AGE, training equipment and contractor support through Category II test.	Missiles and missile-peculiar AGE and training equipment.	Missiles
(3) Same as (1), except only RDT&E on contract		(No production missiles)
(4) Same as (2), except only RDT&E on contract		(No production missiles)

The B-52/FB-111 missiles were characterized as a "compromise" configuration, while the "FB-111 only" was known as the "optimum" configuration. Thus, the competitors were asked to undertake what amounted to a dual contract definition--essentially covering two missile configurations and two aircraft carrier and electronic installations. In addition, alternative bids were requested on the basis of R&D plus production options, as compared to what is normally considered the whole total package concept of R&D in a firm production commitment. Because of the uncertainty of the ultimate use of the SRAM, this duality of the contract definition proposals was rejected and the contractors were asked to repropose on the basis of a new missile configuration characterized as the maximum configuration.

As awarded, the total package contract provides for the design, development, test, and evaluation of the maximum missile configuration and of carrier aircraft

and electronic modifications for both the B-52 and the FB-111 aircraft. It also includes production options which may be exercised at a later date. The first option is for a number of maximized missiles, B-52 fleet modification kits, missile-peculiar AGE and B-52/FB-111-peculiar AGE. A second option is for a similar number of missiles, missile-peculiar and FB-111-peculiar AGE. Additional priced options for production missiles in substantial quantities are provided under each of the key production alternatives and a sliding scale of target costs is provided for potential slippages in the production option decision dates. The contract also provides for all logistics support through Category II testing to be provided by the contractor. The production options cover training equipment and AGE up to but not including the depot level, contractor technical services, and training needs through the squadron activities period.

RDT&E spares will be provisioned under the contract and within the applicable target profit, ceiling price and incentive provisions. Rather than attempting to establish a spare parts pricing list in production, a new spare parts pricing methodology has been incorporated in the SRAM contract. Basically, this methodology calls for the pricing of spares to be provisioned at a maximum price to be determined on the basis of the summation of total item or sub-item price, less assembly and testing costs.

CONTRACT SPECIFICS

The initial contract for the RDT&E under which any subsequent production logistic support could be ordered provides for a 10 per cent profit and a 130 per cent ceiling on a target cost of \$30 million. The cost incentive share is initially established at 80/20 and provides for the flexible-incentive unilateral upward adjustment by the contractor. The Boeing Company was awarded the contract over the only other competitor, Martin Company.

APPENDIX D

PROCUREMENT ELEMENTS--MARK 17 REENTRY SYSTEM

PROGRAM DESCRIPTION

The objective of the Mark 17 Reentry System program was to provide a high-performance, low-radar-cross-section, hardened reentry vehicle for use with the improved Minuteman ICBM Weapon System 133B. The reentry vehicle was to provide delivery of a nuclear warhead with greater precision and enhanced penetrability capabilities than on previous Minuteman missile systems. The Mark 17 mission requirement was to achieve high effectiveness against hard, undefended targets. Security classification prohibits further description of the program.

SCOPE

The scope of work to be performed in development of the Mark 17 Reentry System included research, design, test and evaluation (RDT&E). In addition, a specific quantity of operational reentry vehicles were to be delivered, with options for follow-on quantities. The support equipment required for the program included aerospace ground equipment (AGE) and training support through Category II testing. No provision was made for follow-on training and spare parts.

SCHEDULES

During the pre-contract definition period (officially termed the concept formulation phase), many contractors independently studied the reentry system

development. This pre-CD phase lasted from October, 1964 to April, 1965. On April 22, 1965, fourteen contractors received requests for proposals (RFPs) to compete in the 8-week CD phase. In June, 1965, proposals for the Mark 17 contract definition phase were submitted to the Air Force Ballistic Systems Division (BSD) by Avco, General Electric, and Chrysler. Two procurement approaches were required by the RFP. One was based on a contractor-furnished arming and fuzing system (AFS); the other made use of a government-furnished AFS (Naval Ordnance Laboratory, White Oak, Maryland). Avco and GE both recommended the use of a contractor-furnished AFS because of the intimate interrelationship of the AFS with other reentry vehicle factors and the application of current and past Minuteman system experience. The Chrysler approach is not known, since Chrysler withdrew its proposal after it had been formally submitted.

In August, 1965, Avco and GE were awarded contract definition contracts, each in the amount of \$175, 000. The two-month contract definition phase was concluded, and bids were submitted to the Air Force in October, 1965. In late November, 1965, BSD requested complete reproposals from Avco and GE, within a ten-day response time. Simultaneous negotiations with Avco and GE were concluded by BSD early in December, 1965, with both contractors signing binding contracts for a program start of January 1, 1966. A month-to-month sustaining effort by both contractors, through January, 1966, was authorized by BSD after receipt of the CD proposals (June, 1965). The government did not award the contract in January; therefore, Avco and GE were nominally

funded during January and February to maintain their key personnel of the CD team. Presumably, GE was informed that it was unsuccessful on March 1, since only Avco received funding for "key personnel support" during the month of March. Avco received the contract on April 7, 1966 with the period of performance unchanged. A few days later, Contract Change Notification No. 1 was also received with an effective date of April 7, 1966, which changed several significant design requirements, most notably the maximum weight.

Other associated contractors, such as Sandia (the warhead contractor), Autonetics (the missile guidance contractor), and Boeing (the weapon systems integrator), had not been authorized to continue their activities beyond the CD proposals. In June, 1966, these associates were brought on contract to support the Mark 17 Reentry System program.

The initial period of performance for the total scope of effort was to end in August, 1969. A subsequent contract change extended the program one year.¹

RFP REQUIREMENTS

Competition Groundrules

Contractors were advised that their original proposal could be considered by the Air Force as final without extending the privilege of revising the quotation or conducting further negotiations. The RFP further stated that considerable emphasis would be placed on the technical and

¹ In January of 1968 the Air Force cancelled the Program.

management portions of the CD proposals, and that those contractors participating in the contract definition phase would be evaluated by a source selection board, with considerable emphasis being placed on cost.

Contractor Proposals

Contractor CD proposals were required to be prepared in two parts--a technical and management proposal and a cost proposal. Both parts were required for each of the three contractor-participation phases identified in the RFP--Phase IB (contract definition), Phase II (R&D), and Phase III (production). Proposals for Phases II and III were only required for "planning purposes." In essence, they were budgetary estimates for the cost. Competitors for the CD were informed in the initial RFP that Phases II and III would be fixed price incentive, firm target (FPIF) contracts with possible performance incentives.

Cost Arrangements

On August 9, 1965, the contractors received a letter from the Air Force Contracting Officer stating that the model contract contained in the RFP was to be revised, and identifying the terms of an FPIF contract. This letter stipulated that the target profit for the R&D phase was not to exceed 9 per cent, with a ceiling price of 125 percent of total target cost and a cost sharing incentive formula of 90 (government)/10 (contractor). It also contained notice that performance incentives should be consistent with the following provisions:

1. The factors against which performance incentives will be applied will be developed pursuant to the statement of work and any negotiations relating thereto.
2. The composite value of the various performance incentives will range to ± 3 per cent of the total target cost.
3. Contractors are encouraged to submit an alternate FPIF proposal with a different target, price ceiling percentage, or cost incentive sharing formula; however, reasons must be provided why the alternate proposal would be more advantageous to the government.

This letter also included an option clause for the production effort. Quantities set forth for production in the model contract were on the basis of an FPIF-type contract. The production task was to have a total target profit not to exceed 8 per cent, a ceiling price of 120 per cent of total target cost, and a cost incentive formula of 75/25. This production profit arrangement was also open to an alternate proposal by the contractors, provided they furnish the rationale to support the proposal.

Performance Incentives

The contractors were asked to develop and propose performance incentives applicable to the Phase II contract work, considering, among other things, the factors and suggestions set forth in the RFP. These performance incentives should include reasonably achievable targets for

improvement in the government's established minimum requirements, and should provide effective performance/cost trade-offs based on the proposed cost incentive formula. The incentives suggested by the RFP were the following:

1. Schedules or Milestones
2. Reentry System Operational Weight--This would include a specified target weight based upon proposed baseline design, actual weight versus fee spread, and method of measurement and application for this incentive.
3. Reentry System Hardening--This would be based on the nuclear environment which the system will withstand, fee spread relating to actual performance versus target performance and method of measurement and application for this incentive.
4. Reentry System Performance--This would include definition or identification of reentry system performance in terms of separation system, attitude control, arming and fuzing, surviving reentry environments, etc., and the method by which the flight test program will be used to demonstrate conformance to these requirements, fee spread relating actual performance achieved versus target performance and method of measurement and application for this incentive.
5. Free Space Radar Cross Section--This should include the ratio of target value free space radar cross section to target value fee

spread, relating actual value of radar cross section achieved, method of measurement and application for this incentive.

6. Flight Test Performance--This should include definition of how the performance of each flight test would be measured, defining the target value of flight test performance, method of measurement and application of this incentive.

Additional Features

The model contract did not contain any reference to particular contractual items that would indicate the "total package concept" procurement. The RFP stated that the procurement would be "total package" and that offerors were directed to AFSCM 375-4 for background information in understanding the concept.² There were no specific clauses requiring total system responsibility by the contractor. Facilities were to be provided at contractor expense. The government controls were no different than previous contracts administered under R&D-only fixed price incentive contracts. In fact, usual type of technical direction activity was indicated. Changes were subject to the normal change clause, with no floor on the amount or cost of changes.

CONTRACT SPECIFICS

Contract AF04(694)-888 for Phase II and production was awarded to Avco for a total price with direction to segregate target costs for Item I

² AFSCM-375-4 (Rev. May 31, 1966) is an Air Force Manual outlining System Program Management Procedures.

(R&D), \$36.49 million, and Item II (Production), \$27.09 million. Separately identified target prices were to facilitate funding allocations. The target profit (8.6 per cent) was an average of the profit quoted for R&D and production, with a cost share ratio of 80/20 up to a ceiling of 122 per cent of target costs on the total procurement. Target prices for production options A & B were \$13.9 million and \$19.1 million, respectively.

The first contract change, received the day after contract award, increased the target cost by 7 per cent on Item I and 20 per cent on Item II.

The performance incentives established in the basic contract were as follows:

1. A Flight Performance Index provided a \$1.3 million increase in profit for an "index" greater than 0.9, incrementally decreasing to a loss of \$2.016 million for an index of 0.69 or less.
2. A \$168,000 incentive was established to meet the target weight, with no penalty for overweight but an additional profit of \$336,000 for underweight.
3. An additional incentive was provided for packaging the government-furnished arming and fuzing system. The profit adjustment for this was an increase of \$336,000.

The issuance of the first contract change had an impact on the above performance incentives, and the final negotiation of the first change deleted all performance incentives.

APPENDIX E

BACKGROUND DATA QUESTIONNAIRE

TOTAL PACKAGE PROCUREMENT

(Confidential - not to be used without expressed consent of Prime Contractor)

Official Program Title: _____

Prime Contractor: _____ Parent Company _____ Division/Address/Tel. No. _____

Project Director/Manager: _____

Contract Administrator:

Customer:

Procuring Agency:

Using Agency:

Project Officer: _____

Contract Administrator: _____ Name _____ Affiliation _____ Tel. No. _____

System Project Officer: _____

Local AFPRO: _____

Basic Contract Info.:

Contract No. _____

Security Classification: _____

Type of Contract: _____
(Fixed Price Incentive; Firm Target; Successive Targets)

Target: Cost _____ Profit _____ Price _____

Ceiling Price: _____

Sharing: _____
(Original and date of subsequent changes)Other Special Provisions: _____
(attach chart if convenient)

_____Incentives: Schedule: _____

_____Performance: _____

_____Options: _____

_____Period of Performance: RDT&E _____
(Cite differences from RFP)Production: _____

Change Status: (Cost items only - undefined and probable growth)
Use additional pages if required.

Brief Description (design,data, sched.)	Estimate Cost	Initiator		Date of Change Action (by A.F.)
		Customer	Contractor	

Pre-TPPC Contract Activity:

Conceptual Phase: Period of Performance _____

Funding, Company _____ Gov't. _____

Direct Manpower _____
peak month

Indirect Manpower _____
peak month

Prelim. Definition Phase: Period of Performance _____

Funding, Company _____ Gov't. _____

Direct Manpower _____
peak month

Indirect Manpower _____
peak month

Contract Definition Phase: Period of Performance _____

Funding, Company _____ Gov't. _____

Direct Manpower _____
peak month

Indirect Manpower _____
peak month

Date: CDP/RFP Received _____

CDP Bid (TPPC) _____

Bid Repriced
(if applicable) _____

Date: _____

APPENDIX F

THE FLEXIBLE INCENTIVE CLAUSE

One additional innovation instituted along with the total package concept was the flexible incentive. This is a special provision that at specified times during the life of a contract, the contractor is given the opportunity to increase his savings and profits while also risking losses. When a contractor feels certain that the danger of failure is negligible, he can choose to gamble for an increased share of the cost savings above the initial cost share ratio (in the case of the C-5A, 15 per cent) up to a maximum of 50 per cent on the work still to be done. This incentive, says Secretary Charles, "is to instill in the contractor the cost reduction motivation that comes with great risk without in fact exposing them to great risk."¹

In recognition of the dual desire to temper the risk of the total package program entered into competitively, and simultaneously to improve a strong incentive to motivate high quality at low cost, a flexible cost incentive formula has been developed. The contractors share in cost overruns and underruns, which may start out at a relatively mild figure, and may be adjusted voluntarily and unilaterally by the contractor during the performance of the contract. In this way, if he can reduce his costs, he will be able to generate higher incentive profits by increasing his share in cost underruns.

¹John Mecklin, "The Ordeal of the Plane Makers," Fortune (December, 1965), 158-292.

As in the case of the usual incentive contract, the flexible incentive requires the establishment of a target cost, a target profit, a ceiling price, and an initial cost sharing arrangement for deviations from the target cost. In the case of the C-5A, there were two bases--70/30 and 85/15. The essential feature of the flexible incentive is that the contractor will be permitted from time to time to unilaterally change his share in cost overruns and underruns by electing a higher or lower incremental share on the work remaining to be performed. These incremental shares are weighted to reflect the percentage of work performed while each incremental share is in effect, and are then combined to produce a composite share which will ultimately be used to determine the contractor's award or penalty.

The following limitations on this unilateral right on the part of the contractor have been used:

1. The contractor's maximum incremental share is 50%.
2. The contractor may not change his share before 25% or after 75% of the target cost has been incurred nor more frequently than once a year.
3. An incremental share may not be lower than half of the immediately preceding incremental share, and in no case lower than the share initially established in competition.

Thus, an initial share of 15%, a 50% restriction on incremental shares and a prohibition against increasing the share before 25% of the work has been performed limits the maximum composite cost share to 41-1/4% computed as follows:

$$\begin{aligned} .15 \text{ incremental share } \times .25 \text{ expended} &= .0375 \\ .50 \text{ incremental share } \times .75 \text{ unexpended} &= .3750 \end{aligned}$$

for a total of .4125.²

² Total Package Procurement Concept, A Report Prepared by the Department of the Air Force (May 10, 1966), p. 18.

To encourage the contractor to voluntarily steepen his cost share (which would represent greater risk), and to do so as soon as possible, the formula provides an increase in the target profit of 15 per cent of any increase in the contractor's composite share, multiplied by the amount of work remaining on the date of election. This automatically places a premium on increasing the share as soon as possible. For example, if the maximum incremental share of 50 per cent is elected when only 25 per cent of the work has been performed, the contractor's actual profit will be greater until his actual cost exceeds the target cost by 11-1/4 per cent. If the maximum share is elected when 50 per cent of the work has been performed, this break-even point is reached when actual costs exceed the target by 7-1/2 per cent. If such election occurs when 75 per cent of the work has been performed, the break-even point is at 3-3/4 per cent of target cost. A similar reduction in target profits occurs whenever the contractor elects to decrease his cost share. As explained by the Boeing Company:

Using a typical C-5A type example of a \$1 billion target cost, a 10 per cent target profit of \$100 million and a 15 per cent original cost-share ratio; if the contractor, after expenditure of \$250 million, increased the ratio to 50 per cent, his composite target profit would be increased to \$129.5 million (10 per cent on first \$250 million plus 13.94 per cent on \$750 million still unexpended) and his composite cost-share ratio would be increased to 41.25 per cent (first \$250 million at 15 per cent plus \$750 million at 50 per cent divided by \$1 billion, original target cost).

Voluntary steepening of the contractor's cost-share ratio (which would represent an assumed greater risk) would be encouraged by a proportional increase of the target profit on the then remaining work (e.g., approximately 0.15 for each 1 per cent of increase to the composite cost-share ratio). Mathematically, these procedures would result in a composite target profit, and a composite cost-share ratio, computed by determining the weighted averages of the incremental target profits and cost-share ratios.

The computations are as follows:

- 1) Composite Profit (CP) = $0.10 + 0.75(0.15)(0.4125 - 0.15)$
 $= 0.10 + 0.1125(0.2625) = 0.10 + 0.02946 = 0.1295.$
- 2) Target Profit (TP) = Target cost x CP = \$1 billion x 12.95%
 $= \$129.5 \text{ million.}$
- 3) Profit Rate for Balance of Program $\frac{0.25(0.10) + 0.75(x)}{\$1 \text{ billion}}$
 $= 0.1295; 0.025 + 0.75x = 0.1295; x = 0.1394.$

Incremental Profit above Initial 10% TP = 0.0394 or 3.94%.

- 4) Composite Cost-Share Ratio

$$\frac{(\$250 \text{ million at } 15\% + \$750 \text{ million at } 50\%)}{\$1 \text{ billion}} =$$

$$\frac{\$37.5 \text{ million} + \$375 \text{ million}}{\$1 \text{ billion}} = 41.25\%.$$

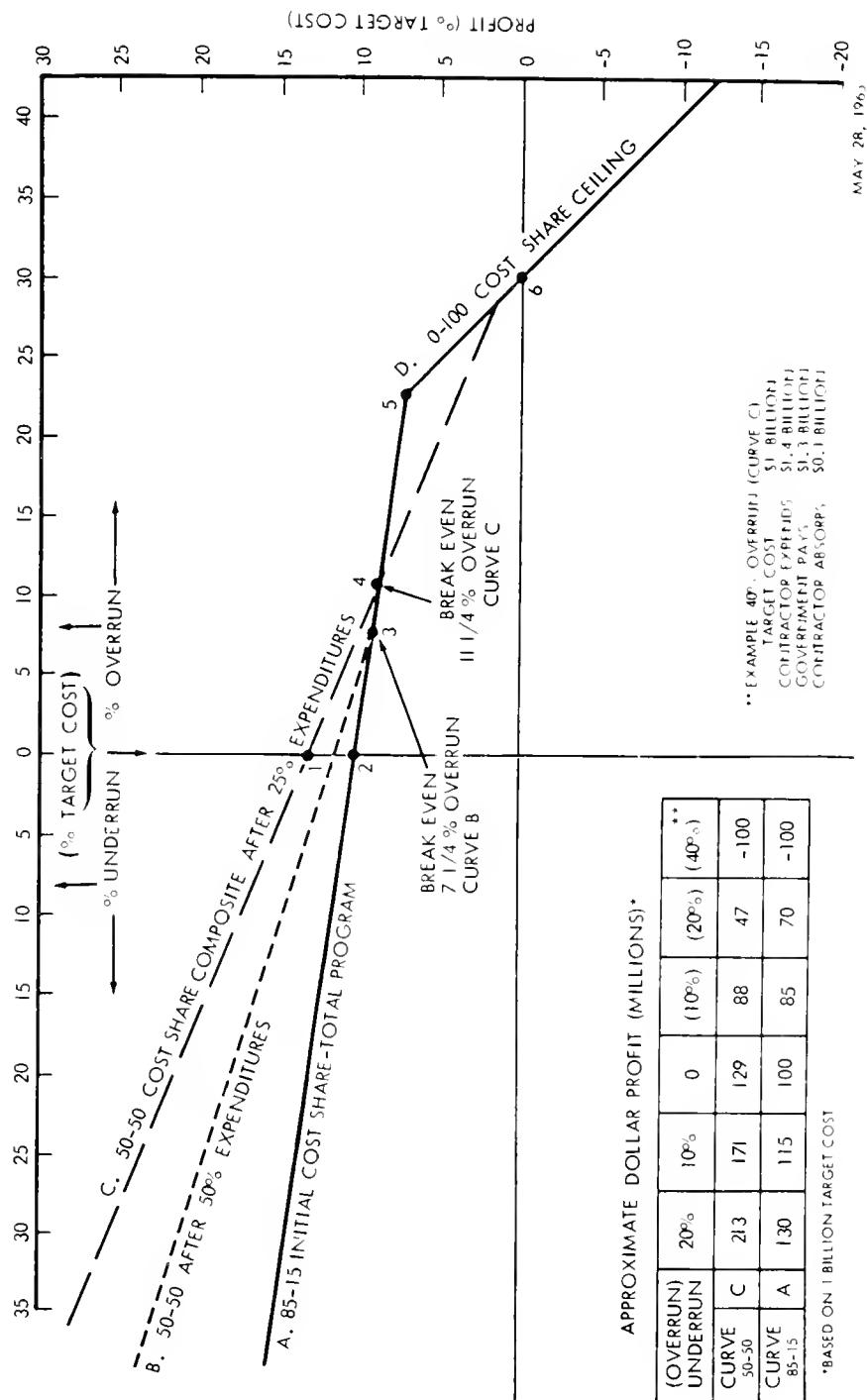
- 5) Direct Calculation of Incremental Profit Rate (IPR) =
 $0.15(0.4125 - 0.15); IPR = 0.15(0.2625) = 0.0394.$
- 6) Cost Overrun Protection (COP) =

$$\frac{0.15 \times \text{Composite Cost-Share Ratio Increase}}{\text{Resultant Composite Cost-Share Ratio}} \times \text{Then Unexpended}$$

$$\text{Target Cost} = \frac{0.0394}{0.4125} \times \$750 \text{ million} = \$71.3 \text{ million.}$$

Thus, contractor breaks even with his assumed \$100 million target-profit if his actual costs do not exceed \$1,071,300,000, which is a \$71.3 million overrun as compared to original target cost of \$1 billion.

The curves on ... [the following page] represent the minimum and maximum degrees of risk available to a contractor under one of the variable cost-sharing plans in the C-5A program.... Curve A, for example, is derived from the initial program cost share of 85:15. Basically, the contractor expects to pay 15 per cent of his costs in excess of the negotiated target costs and pockets 15 per cent of his underruns. The contractor, however, has the option to increase his cost-share ratios once the contract is 25 per cent completed. If he elects the maximum cost share of 50-50 at this time, he will be in a position to maximize his profits and, of course, his losses.... This condition is described by



Curve C. All other conditions lie between Curves A and C; Curve B, for example, shows the profit performance expected when a maximum cost share of 50-50 is exerted after 50 per cent of the program is completed.

Note that if Curve A was not intercepted by Curve D, it would show profit until a 175 per cent overrun to the target cost; in fact, at least a 3 per cent profit could be earned up through a 140 per cent overrun. To deter this possibility and force realism into the contractor's target cost, a cost ceiling is established that eliminates all profit at a 130 per cent overrun while requiring the contractor to share 100 per cent of all costs. This limiting condition is shown on Curve D. Note that under the basic cost-share plan (Curve A) the contractor starts 0-100 per cent cost-share formula at Point 5, so his profit potential breaks rapidly from that point on. Some of the important aspects of these curves are:

- The composite profit for a target performance using Curve A for the whole program is 10 per cent (Point 2).
- The contract sharing, following Curve A, shifts to 0-100 at 123.5 per cent overrun to target cost (Point 5).
- The contractor will make more profit by electing the cost-share option in Curve C than he will through the initial cost-share until he experiences an 11.25 per cent target cost overrun (Point 4) or a 7.5 per cent target-cost overrun on Curve B (Point 3)....
- The composite profit rate for on-target performance using Curve C is 12.95 per cent (Point 1).
- Profit drops to zero on all cost-share options when expenditure runs 130 per cent of target cost (Point 6).
- The contractor's composite cost-share ratio following Curve C is 41.25 per cent.
- Curve C intersects Curve D at 128.8 per cent overrun to target cost.

The table provided with the graph gives examples of profits that would accrue in accordance with Curves A and C based on a billion-dollar target cost. Note that losses of \$100 million could occur on a 140 per

cent overrun. The catastrophic effect of such an overrun is softened by a recoupment provision of the C-5A plan that applies if a contractor's expenditures equal or exceed a 130 per cent target-cost rate for RDT&E and the first production quantity. Similar adjustments are applied if the contractor experiences excessive underruns.³

³ Total Package Concept or Single Contract Procurement, pamphlet prepared by Aerospace Division, The Boeing Company (March, 1967), pp. 63-65.

APPENDIX G

PERFORMANCE INCENTIVE--C-5A

To better understand the complexities of a performance incentive, the entire contents of the special incentive provision for the C-5A contract is presented in this appendix. Supplemental Agreement Number 16 to the Lockheed contract was executed soon after the award of the contract at no change in target cost or target price. The reward paid by the government to the contractor for performance was tied to a productivity index which included payload, weight, range, and velocity of the aircraft. The government, after the issue of this supplemental agreement, selected the 70/30 - 50/50 sharing arrangement, thus providing the contractor with a maximum reward of 22.5 million dollars. Text of the special incentive provision of the C-5A contract (Supplement Agreement No. 16) follows:

PART XIII SPECIAL INCENTIVE PROVISIONA. GENERAL

For purpose of these performance incentive provisions the following shall apply:

1. In the event that the actual productivity of the C-5A airplane as determined by the Government in accordance with the provisions of this Part exceeds the target value in paragraph B.1 below, the Government shall pay to the Contractor an amount of reward as set forth in paragraph B.2 below. In no event shall the amount of reward paid by the Government exceed \$15,000,000.00, except as may be adjusted by paragraph 3 of the part hereof entitled "Changes in Contractor Cost Share." In the event the Government elects to utilize its option to select the 70/30 -- 50/50 sharing arrangement in accordance with the provisions of the part hereof entitled "Adjustment of Sharing Arrangement," the amount of the reward paid by the Government shall not exceed \$22,500,000.00.

2. A productivity index shall be determined by the Government, based on airplane performance data and structural load-carrying capability data. The index shall be determined by the following equation:

$$I_p = PL_1 \times T_1 \times 0.96V_1 + PL_2 \times T_2 \times 0.98V_2$$

where:

I_p = productivity index in average ton-nautical miles per day per plane.

Subscript 1 denotes representative mission number 1 on which maximum payload is transported 2700 nautical miles at a structural design limit load factor not less than 2.25 and in accordance with MIL-C-5011A rules.

Subscript 2 denotes representative mission number 2 on which maximum payload is transported 5500 nautical miles at a structural design limit load factor not less than 2.5 and in accordance with MIL-C-5011A rules.

PL = payload in tons

T = hours per day per airplane for each representative mission fixed as 3.33 for mission number 1 and 1.67 for mission number 2.

V = average long range cruise speed in knots true air speed (KTAS) for each of the two representative missions.

0.96 and 0.98 are coefficients to convert long range cruise speed to block speed.

3. In the event that the value of the productivity index determined by the Government exceeds the target value established in paragraph B.1 below, the Government shall pay to the Contractor an amount computed in accordance with the formula in paragraph B.2 below.

4. In ascertaining the Contractor's entitlement to incentive reward, if any, pursuant to this Part, the Government shall use performance data accumulated by it through 31 December 1969 and structural data accumulated by it through 30 April 1970.

5. In the event that the Government determines that either of the airplane payload values specified in paragraph B.1 of this Part has not been met, the Contractor shall not be entitled to payment nor shall the

Government make payment to the Contractor pursuant to these performance incentive provisions. In the event that the actual speed for long range cruise is determined to be less than the value specified in paragraph B.1 below, the payload shall be determined on the basis of cruising at the specified speed.

6. The configuration used in computing actual performance for the purpose of these performance incentive provisions shall be established in accordance with paragraph C of this Part.

7. The actual performance for the purpose of these performance incentive provisions shall be measured and determined in accordance with paragraph D of this Part.

8. Specification MIL-C-5011A referenced in this Part is dated 5 November 1951.

9. Upon completion of the measurement and determination of actual performance pursuant to this Part, this contract shall be promptly amended by a supplemental agreement setting forth any incentive increment of increased performance attained by the aircraft.

10. The supplemental agreement evidencing the total final price of the contract pursuant to the clause of this contract entitled "Incentive Price Revision (Firm Target)," shall establish the amount of reward earned, if any, and shall provide for payment of such reward resulting from the provisions of this Part.

11. Any incentive reward earned by the Contractor shall be in addition to the total price determined to be payable under this contract. Any such amount shall not be subject to the clause of this contract entitled, "Incentive Price Revision (Firm Target)."

B. INCENTIVE FORMULA

1. The target value of the productivity index is 222,379 average ton-nautical miles per day per airplane, based on the following values of the parameters in the equation in paragraph A.2 of this part, as set forth in Contractor Specification SS40001 dated 9 September 1965.

Mission number 1:

Limit load factor = 2.25

Range = 2,700 nautical miles

Payload = 265, 000 pounds = 132.5 tons

Average long range cruise speed = 440 KTAS

Mission number 2:

Limit load factor = 2.5

Range = 5, 500 nautical miles

Payload = 100, 000 pounds = 50 tons

Average long range cruise speed = 440 KTAS

2. In the event that the actual productivity index determined by the Government exceeds the target value in paragraph B.1 above, the per cent increase in potential productivity shall be determined by the Government by means of the relationship

$$\left(\frac{\text{Actual } I_p - \text{Target } I_p}{\text{Target } I_p} \right) \times 100,$$

and the Government shall pay to the Contractor an amount computed by multiplying the per cent increase in potential productivity up to a maximum of 15% by \$1, 000, 000.00, except as may be adjusted by paragraph 3 of the part hereof entitled "Change in Contractor Cost Share." In the event the Government elects to utilize its option to select the 70/30 -- 50/50 sharing arrangement in accordance with the provisions of the part hereof entitled "Adjustment of Sharing Arrangement" the Government shall pay to the Contractor an amount computed by multiplying the per cent increase in potential productivity, up to a maximum of 15%, by \$1, 500, 000.00.

C. ESTABLISHMENT OF CONFIGURATION TO BE USED IN COMPUTING ACTUAL SPEED AND RANGE PERFORMANCE

1. The weight empty shall be determined by weighing production airplane numbers 1, 2, 7, 8 and 9, and averaging the adjusted weights after adjusting the measured weight of each to include the effect of Engineering Change Proposals (ECP's) as defined below:

a. Those affecting weight only which by 31 December 1969 have been directed by the Air Force Contracting Officer to be incorporated.

- b. Those affecting airplane performance by means other than weight alone, which have been directed by the Air Force Procuring Contracting Officer to be incorporated, and the effects of which have been determined by Air Force Flight Test Center flight test by 31 December 1969.
 - c. Those affecting structural load-carrying capability which have been directed by the Air Force Procuring Contracting Officer and the effects of which have been determined by static test and/or structural analysis by 30 April 1970, provided the test results and/or analysis are approved by the Air Force.
2. The aerodynamic configuration shall include ECP's which have been directed by the Air Force Procuring Contracting Officer to be incorporated and which have been tested by the Air Force in the Category II Flight Test Program as of 31 December 1969.
 3. The structural load carrying capability shall be that approved by the Air Force and shall be established by static test and/or structural analysis accomplished by the Contractor by 30 April 1970.
- D. MEASUREMENT AND DETERMINATION OF ACTUAL PERFORMANCE
1. The Air Force shall conduct the performance and stability flight tests on which the reward payment is based. Applicable test instrumentation, facilities and data reduction methods shall be determined by the Air Force. Unless specifically stated otherwise, all altitudes shall be pressure altitudes and data shall be reduced to standard day temperatures as required by MIL-C-5011A.
 2. Structural capability and flutter limitations shall be those determined from Contractor-conducted tests and approved by the Air Force. Structural capability shall be determined from the Structural Static Test Program and the Flight Loads Survey Program. The maximum gross weight used to determine payload shall be the design weight used to establish loads for application in the Static Test Program or the approved operating weight resulting from the Static Test and Flight Loads Survey Programs, whichever is less. Flutter limitations shall be determined from wind tunnel tests and flight flutter tests.
 3. The computation of the payload and speed capabilities used to determine the payment of reward shall be made by the Air Force in accordance with MIL-C-5011A rules.

4. Prior to obtaining flight test data, engines of the performance test airplane shall be trimmed to produce the minimum guaranteed, standard-day, sea level, take-off thrust stated in engine specification CP45A001A as approved by the Air Force at the time of the test.

5. In addition to MIL-C-5011A requirements, the following additional rules and procedures apply to payload determination:

a. The take-off weight value used in determining payload for the missions in paragraph B.1 shall be that corresponding to the most limiting of the following:

(1) The weight which Air Force flight tests indicate to be the maximum for taking off in the distance specified at the temperature specified in specification CP40002 dated 9 September 1965.

(2) The weight which Air Force flight tests indicate to be the maximum for climbing with one inoperative engine at the rate and conditions specified in paragraph 3.1.1 f.(2) of specification SS40001 dated 9 September 1965. (This requirement applies only to Mission number 2 in paragraph B.1 of this Part.)

(3) Weight limitations, if any, imposed because of the minimum control speed with the most critical engine inoperative, as established by Air Force flight test.

(4) The weight corresponding to the limit load factor for each mission and the Air Force approved structural-load carrying capability in accordance with paragraph C.3 and D.2 of this Part.

(5) Weight limitations, if any, imposed because of flutter characteristics revealed by tests described in paragraph D.2 of this Part.

(6) Weight limitations, if any, imposed because of stability and control characteristics throughout the flight profile as determined by Air Force flight test.

(7) Any other gross weight limitations revealed by Air Force flight test to be pertinent to the missions in paragraph B.1 of this Part.

- b. In determining take-off performance, the engines shall be run at take-off power for sufficient time to stabilize exhaust gas temperatures and turbine RPM prior to brake release.
 - c. Range shall be as specified in paragraph B.1 of this Part.
 - d. JP-4 fuel (in accordance with specification MIL-J-5623F-2 dated 14 May 1964) shall be used.
 - e. Insofar as practicable, payload and range performance data shall be obtained using the fuel sequence prescribed in the C-5A Flight Handbook. No corrections shall be made for center of gravity location and associated trim drag.
 - f. In the event that the speed for long range cruise in accordance with MIL-C-5011A rules is determined to be less than 400 knots, the payload shall be determined on the basis of cruising at 440 knots.
 - g. Range data shall be corrected for differences in engine specific fuel consumption (SFC) between those values specified in General Electric Specification CP45A001A dated 20 April 1965, as revised 1 July 1965, and those values established by the engine Contractor and recognized by the Air Force as actual engine performance at the time of the aircraft performance flight tests. Take-off performance data affecting the range/payload relationship shall be corrected for differences in take-off thrust between that specified in General Electric Specification CP45001A dated 20 April 1965, as revised 1 July 1965, and that established by the engine Contractor and recognized by the Air Force as actual engine performance at the time of the aircraft performance flight test.
6. The airspeed calibration of the performance test aircraft shall be established by the Air Force or have the concurrence of the Air Force.

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	FE 15 '88	
FEB 11 '88	FE 1	
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	JE 24 '88	
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